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Three-dimensional models are used with great effectiveness as teaching aids. Concepts can be much more readily understood when significant relationships and ideas are simplified, exaggerated, and presented as working models. These models can be constructed by teachers and/or by students. The following considerations should be kept in mind: the aid must focus attention on the principle, concept, or idea to be taught; construction should be durable, workmanship of high quality; and operation must be smooth and simple. The teacher must judge which type of model is best suited for his purpose. Models may be classified under the following headings: 1) the cutout, cutaway, or cross-sectional model; 2) the working model; 3) the enlarged model; 4) the reduced model; 5) the scale model; 6) the transparent model; and 7) the mock-up. A variety of colors and materials may be used. The construction of three-dimensional aids can be facilitated through a study of the side variety of devices photographed in this publication. A variety of instructional areas is presented, although most are in the vocational area. An instructor's check-list on the principles and practices related to the use of these aids is presented. The list includes the following headings: planning and preparing, making the presentation, student performance, terminating the presentation, and storing the aid.							
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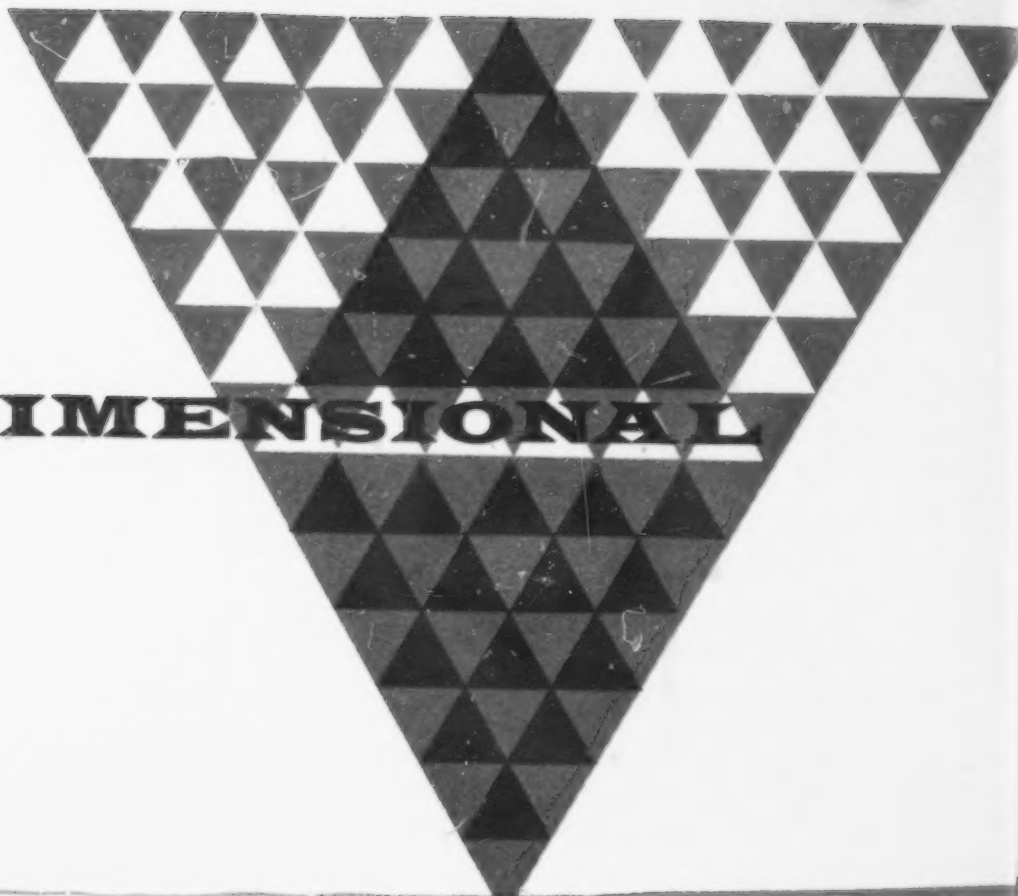
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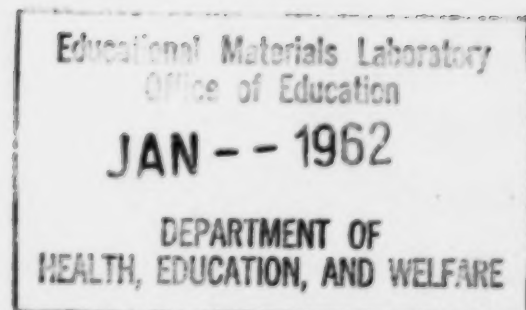
Teaching Aids for Trade and Industrial Instruction

**U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Office of Education**

Three-Dimensional Teaching Aids for Trade and Industrial Instruction

Compiled by
HAROLD J. ROSENGREN
Program Specialist
Trade and Industrial Education Branch
Division of Vocational Education

OE-84024
Circular No. 662



**U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE Abraham A. Ribicoff, Secretary**
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Foreword

THE GROWING BODY OF KNOWLEDGE of importance to workers in skilled and semiskilled occupations becomes more intricate as technological developments unfold. The introduction of many new subject areas into the curriculum has naturally followed and has made competition for the learner's time extremely keen. To assist in offsetting this crowding the curriculum, teachers have come to realize that teaching aids can accelerate the learning and teaching process.

Three-dimensional aids, by their very nature, permit greater visualization than those on a single plane. There has been a lively interest in the development and use of three-dimensional teaching aids since the issuing of the Office of Education publication, 1953, Circular 366, *Three-Dimensional Teaching Aids for Trade and Industrial Instruction*. This publication was developed as a project of the North Atlantic Region Committee on Teaching Aids. Teacher educators and supervisors of trade and industrial education courses, recognizing the importance of a publication showing typical present-day aids, have urged bringing the earlier publication up to date.

This publication contains many variations of those generally accepted teaching aids that should motivate instructors to create new aids, improve upon others, and develop quality instructional programs.

Some of the more effective instructional aids illustrated in this publication have been fabricated from low-cost materials. Others, including the plastic covered cutaways, are made from stock of considerable worth. The value of the aid need not be measured in terms of dollars and cents, but rather by its merit in facilitating learning. Whether the aid is made by student or teacher is of no great consequence; instead, the educational value and the pride of workmanship is the point to be stressed. As an understanding of the value of the three-dimensional teaching aid gains momentum, many original and useful devices will no doubt be contrived. New occupational areas and new equipment will necessitate the creation of instructional aids that will differ radically from those in existence today.

Participants of the Central Regional Conference, meeting in Des Moines, Iowa, in March 1960, agreed to cooperate in bringing out a new issue of *Three-Dimensional Teaching Aids for Trade and Industrial Instruction*. Many conferees expressed the conviction that quality instruction can be enhanced through the effective use of three-dimensional instructional devices.

State supervisors and teacher trainers, asked by group action of the Conference to serve on a committee to implement the project, included: Thaine D. McCormick, Kansas, Chairman; William M. Berndt, Ohio; Donald M. Brill, Wisconsin; Alfred Drew, Indiana; B. T. Fagen, Kentucky; Elizabeth Kerr, Iowa; Harry A. Meinert, Illinois; and Harold J. Rosengren, U.S. Office of Education, Washington, D.C. These Committee members, in turn, solicited the assistance of personnel at the local level to collect photographs of shop-tested, instructionally sound aids. Lane Technical High School, Chicago, Illinois, assisted with the cover design.

The Trade and Industrial Education Branch is grateful to the Committee and to the many educators who contributed their time and talent that this project might reach fruition. The 1961 publication was compiled by Harold J. Rosengren, Program Specialist, Trade and Industrial Education Branch. Included in the appendix is a check list that highlights planning and preparing the teaching aid, presenting new material through the help of the aid, evaluating student performance through its use, and storing the aid.

The name of the contributor, the school he represents, and the town and State are credited under each instructional aid. Your cooperation, however, is solicited in keeping requests for drawings and specifications to an absolute minimum. For additional information, readers should consult the numerous professional articles and books that have been devoted to an exposition of three-dimensional aids rather than contact the individual contributor.

JOHN P. WALSH, *Director,*
Trade and Industrial Educational Branch.

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The Development and Use of Three-Dimensional Aids

THREE-DIMENSIONAL AIDS greatly facilitate teaching and learning. Many mechanisms normally move too rapidly or cannot be easily observed by students. Oftentimes, it is helpful for the learner to see or to operate only one segment of a machine independent of the operation of the whole mechanism. It is important that the student himself manipulate the device in order to get the maximum learning experience from it. Three-dimensional aids overcome many difficulties encountered in teaching the use of the actual machine or the equipment.

As the term implies, an "aid" is intended to help the teacher impart information, ideas, and/or skills. It should be fitted into the teaching process so that the steps of preparation, presentation, application, and testing unfold logically and naturally. The teacher must, therefore, realize the need for the aid, and should decide which device will best facilitate learning and teaching. He must construct an aid that will focus attention on the principle, concept, or idea to be taught.

The instructor will need to select for construction an aid that gives maximum learning within a given set of circumstances. He must choose between samples, cutaways, mock-ups, large scale models, small scale models, or exhibits in arriving at the three-dimensional aid that best meets the teaching situation at hand. Through the use of the aid selected the learner should acquire greater skill and more knowledge in a given period of time than is likely through other means.

The majority of effective three-dimensional teaching aids are planned and constructed by the teacher—oftentimes with the assistance of the student group. Cooperative planning and construction of the teaching aid reinforces learning.

Each device should present a single idea or it should demonstrate a limited series of closely related ideas. Manipulation or movement of the device should clarify or present new ideas or concepts rather than develop skill in manipulation of the aid.

Construction should be durable enough to serve the teaching situation adequately without re-

sulting in embarrassing breakdowns. A unit that is to serve over a long period of time should be built to withstand much student handling.

Workmanship should be of the highest quality. If an aid can teach how a mechanism functions, its appearance and operating smoothness may well teach standards of workmanship as well. Consequently, the model, mock-up, exhibit, or sample should reflect the best standards of workmanship, to which students should aspire in the shop or laboratory.

To justify the making, each teaching aid must actually *aid* learning. Many factors must be taken into account when considering the type of aid that should be built. For example, models may be classified under the following headings*:

1. The Cutout, Cutaway, or Cross-sectional Model
 2. Working Model
 3. Enlarged Model
 4. Reduced Model
 5. Scale Model
 6. Transparent Model
 7. The Mock-up
1. The Cutout, Cutaway, or Cross-sectional Model
The cutout or cross-sectional model is often used where it is necessary to see the interior of a piece of equipment or a machine to understand "how it works." When a portion of an object is cut away, the section remaining should expose the important features of the device. The cross-sectional model is fundamental to the complete understanding of complex devices and mechanisms.
 2. The Working Model
The working model is often considered the most effective aid because it "shows how it works." Working models may range from simple to very intricate, but in all cases they are valuable. This form of teaching aid is needed in a great many teaching situations to supplement complex verbal explanations. It may not look

*Information concerning the seven types of models is adapted from materials available through the Industrial Education Department, the University of Texas, and is used with permission.

exactly like the original, but it still involves the basic principle of operation.

3. The Enlarged Model

The enlarged model is simply a large "working model." It is used effectively when teaching involves the demonstration or explanation of a relatively small object or device. This type of aid strengthens the instructor's explanation, giving more assurance that every student is able to follow each point discussed.

4. The Reduced Model

The reduced model is likewise simply a small "working model." It, too, may not always bear an exact resemblance to the original, nevertheless it demonstrates the basic principle of operation. It is used less frequently than other types of teaching aids. Its use becomes necessary when the real object is too large to be utilized in the school classroom or shop.

5. The Scale Model

Scale models, made to carefully determined measurements including the third dimension, are best used for shop layouts. Cross-sectional models of shops permit more complete visualization of machine locations, material storage space, aisle width, and toolroom placement. Scale models permit changes to be worked out before costly installation is made.

6. The Transparent Model

The widespread use of plastics has stimulated the making of plastic models for teaching purposes. Their chief value lies in the advantage they give the learner in visualizing interior, rear, and side views. The transparent model is a very valuable teaching device for use in a drafting room.

7. The Mock-up

The mock-up is an unnatural layout or arrangement of real parts or assemblies (often mounted on a panel) which shows the interrelationship of the several parts of a mechanical, hydraulic, electrical, or other system, and which can be made to operate upon application of power.

Characteristics of a Mock-up

1. It must have the distinctive parts of the real thing.
2. It must function upon the application of some type of power or energy.
3. It should be simple, for teaching purposes.
4. It should be designed for a specific purpose:
 - a. To show how a mechanism operates
 - b. To train in trouble shooting

- c. To teach a wiring diagram, or a flow circuit
- d. To emphasize a principle (by making visible a portion of the interior of the mechanism through use of glass tubing, plastic cylinder or other suitable material).

These principles should be helpful to the teacher who considers building his own teaching aids.

The construction of three-dimensional aids can be facilitated through a study of the various devices shown in this publication. Construction size and construction materials should be selected so as to contribute to ease of use when handling, storing, and teaching with the aid. Shop teachers with imagination will find little difficulty in constructing aids to meet specific teaching needs.

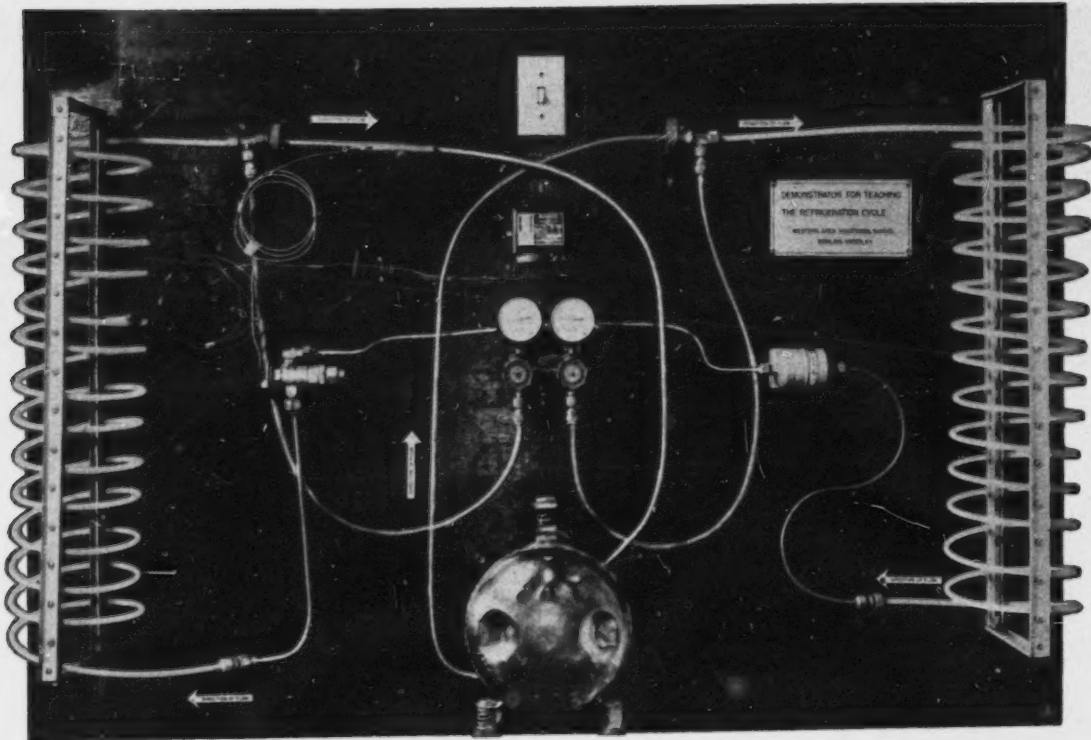
The clever use of paint will contribute greatly to the utility of an aid. Tints should be used rather than bold colors or hues. The more intense colors can be used to focus attention on parts that are of prime importance in the teaching situation. Color contrasts can be used to make obscure areas stand out. Poorly handled coloring is distracting and tends to focus attention on areas of less rather than greater importance. Before painting a model or mock-up, an instructor should study the use of colors in some well prepared wall charts. These charts often suggest color handling that will focus attention on areas of importance.

The instructor with need for an aid to enhance his teaching can obtain numerous ideas through a study of the photographs included in this publication. The principles discussed, together with these photographs, will serve as a guide in constructing aids that should greatly facilitate and enhance teaching and learning.

Illustrated in This Publication

Photographs of a number of student or teacher-contrived instructional aids are shown on the following pages of this publication. Beneath each photograph is a brief statement of the purpose of the teaching aid. With one or two exceptions, lengthy descriptions have been avoided. Persons who are familiar with the instructional areas that are represented will quickly grasp the significance of the aid that is featured.

The instructional areas in which the photographs are grouped are arranged in alphabetical order. A credit line giving recognition to the developer of the device as well as the school system represented has been added under each descriptive paragraph.



REFRIGERATION CYCLE

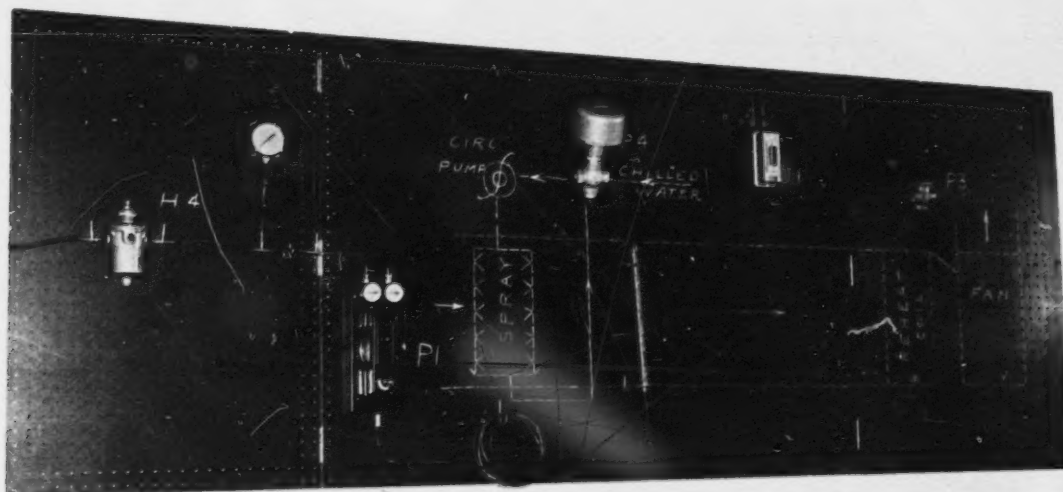
This working mock-up facilitates individual and group instruction in the basic principles of the refrigeration cycle. A hermetically sealed compressor, automatic expansion

valve, temperature and pressure switches combine with clear plastic coils to give the student a good picture of the complete operation.

Robert L. Pillow

Western Area Vocational School

Bowling Green, Kentucky



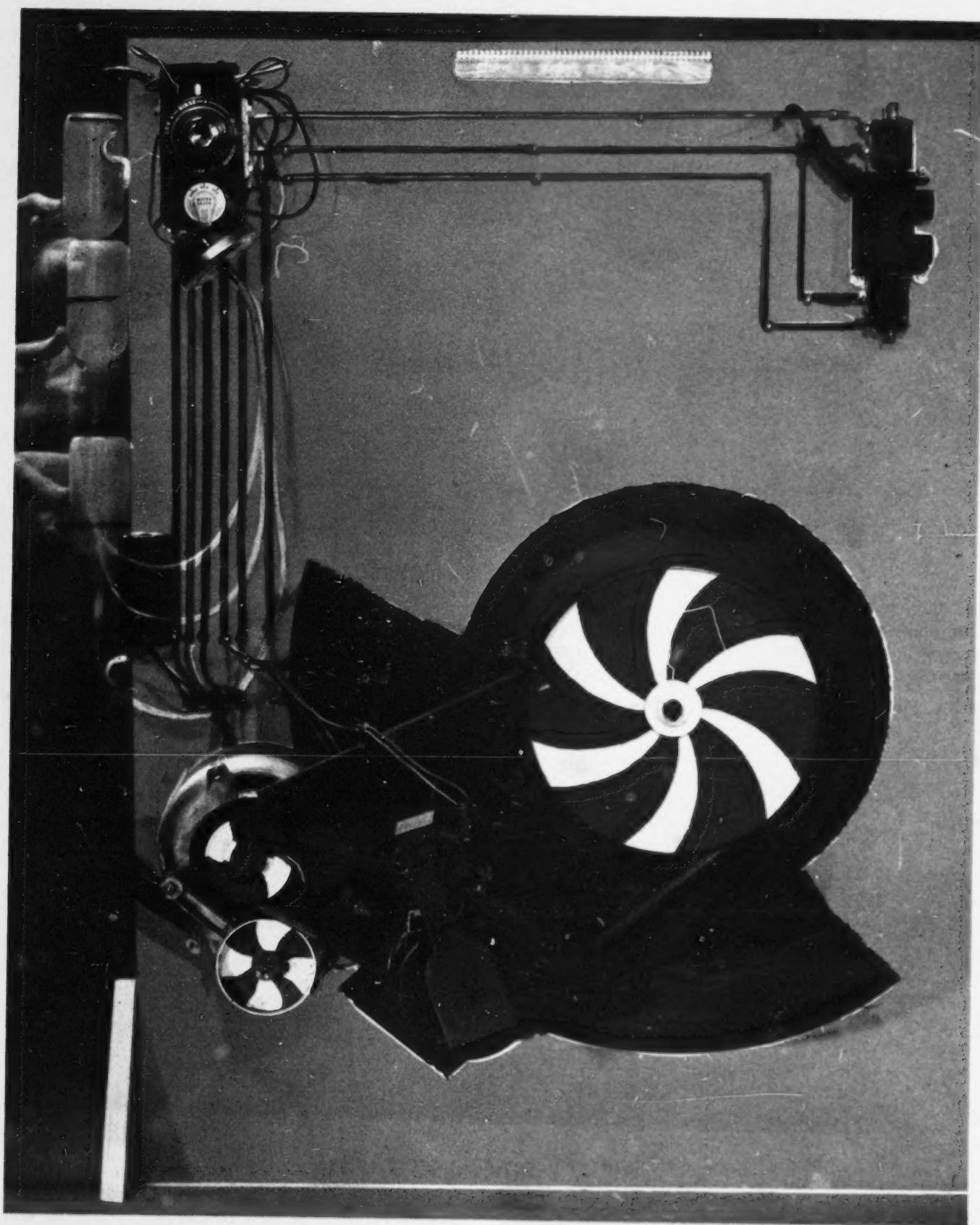
AIR CONDITIONING PANEL

This training panel consists of a folding pegboard panel mounted on a bench-type cabinet. The pegboard is painted with chalk board paint upon which schematic applications, such as the outline of a typical air conditioning unit may be drawn with chalk. Controls can be easily mounted in place on the pegboard with standard pegboard hooks and, by piping individual controls with rubber hose, the operation of a

control system may be demonstrated. A small air compressor which mounts in the bottom of the cabinet is used to furnish a supply of compressed air for the operation of pneumatic controls. Provisions have been made for both 110 volt and 6 volt circuits for electric controls. The entire unit is mounted on wheels so that it may be moved about easily to any classroom location.

Milwaukee Vocational and Adult Education School

Milwaukee, Wisconsin



AUTOMATIC WASHING MACHINE

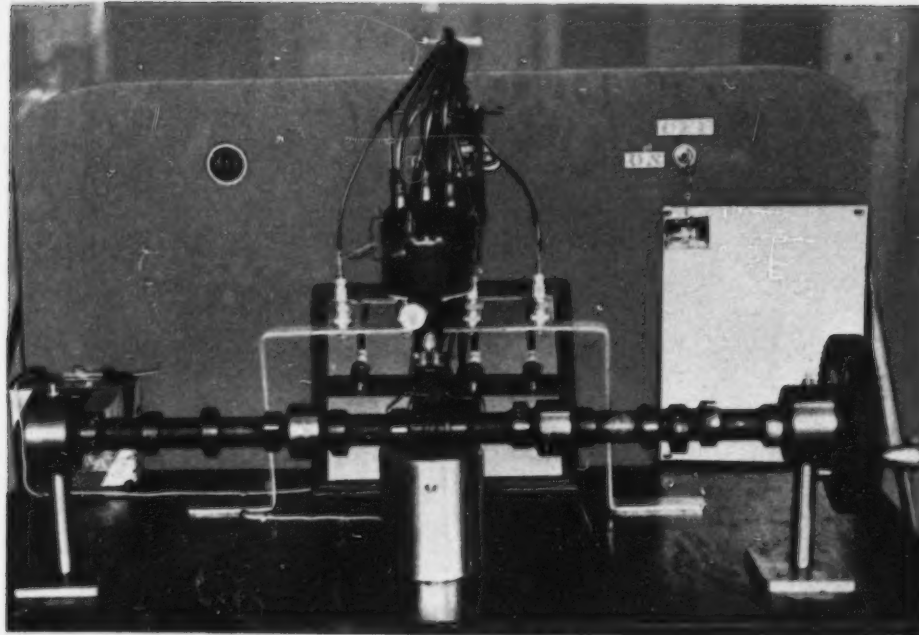
This cutaway of an automatic washing machine mounted on a stand reveals the mechanism which lies behind the porcelain cabinet. The machine is put through the various

cycles by raising and lowering the bottle to the left of the teaching aid.

Robert McWilliam

Kansas State College of Pittsburg

Pittsburg, Kansas



IGNITION CIRCUIT

This mock-up ignition circuit teaching aid permits students to observe the live operation of the distributor and firing of the spark plugs. The white sheet in the right corner gives step by step procedures so the student can make "re-runs"

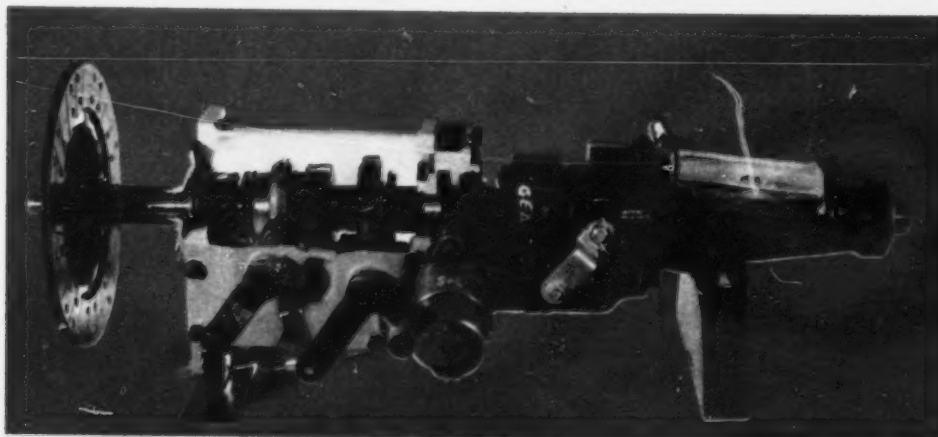
after receiving instruction supplemented with a demonstration.

A mirror, set at 45°, beneath the plugs makes it easy for several students to see the complete operation at one time.

J. G. Davis

Lafayette Area Vocational School

Lexington, Kentucky



OVERDRIVE WITH CONVENTIONAL TRANSMISSION

This aid helps the student to understand the manual and electrical systems of the two-speed planetary transmission.

When the overdrive is not functioning, the planetary gears turn idly and the main shaft of the transmission is connected directly to the overdrive output shaft by a sprag clutch.

The electrical equipment used to control an overdrive unit consists of a solenoid, speed-sensitive governor switch, a relay, a kickdown switch, and a lock-out switch. The manner in which these units are connected makes it possible to operate in overdrive above a pre-set speed or in conventional drive at any speed.

To operate in overdrive, the governor switch, kickdown switch, and lock-out switch must complete the circuit through the relay windings and the relay contact points must close to energize the solenoid. To shift out of overdrive at road speeds the kickdown switch must ground the primary circuit of the ignition system to momentarily release torque, so shift may be made to conventional gear.

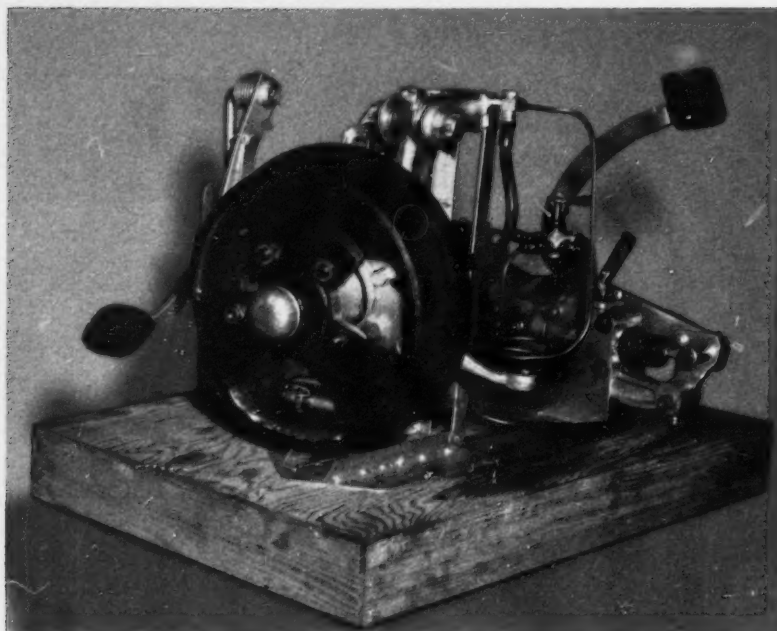
This aid is used in conjunction with a transparent, electrical, schematic overlay.

Noel E. Jones

Boone Community Schools

Boone, Iowa

AUTO MECHANICS



HYDRAULIC AND POWER BRAKE

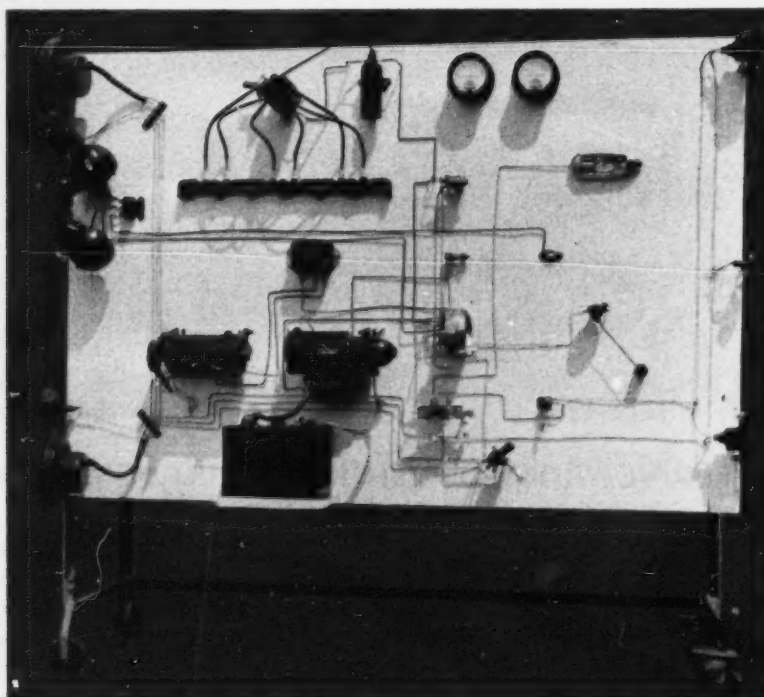
A two-way valve enables the demonstrator to change from conventional hydraulic to power assisted brakes. Vacuum is obtained by connecting a hose to the intake manifold of a live shop engine or auto. The cutaway drum

permits the student to see the internal construction of the wheel and provides an aid to the instructor in demonstrating major and minor brake adjustment.

William B. Turner

Indiana State Teachers College

Terre Haute, Indiana



AUTOMOTIVE ELECTRICAL SYSTEM

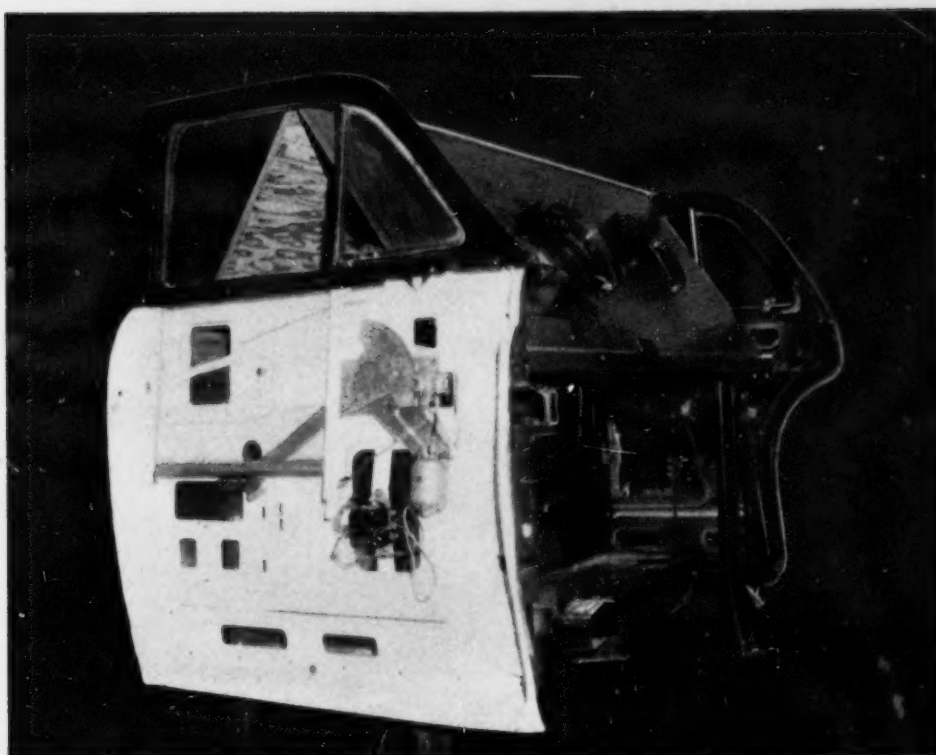
This demonstration panel duplicates the standard auto electrical system. The unit is portable and can be easily

moved into the related classroom along with testing instruments for demonstration purposes.

Noble Mackey

Sandusky Public Schools

Sandusky, Ohio



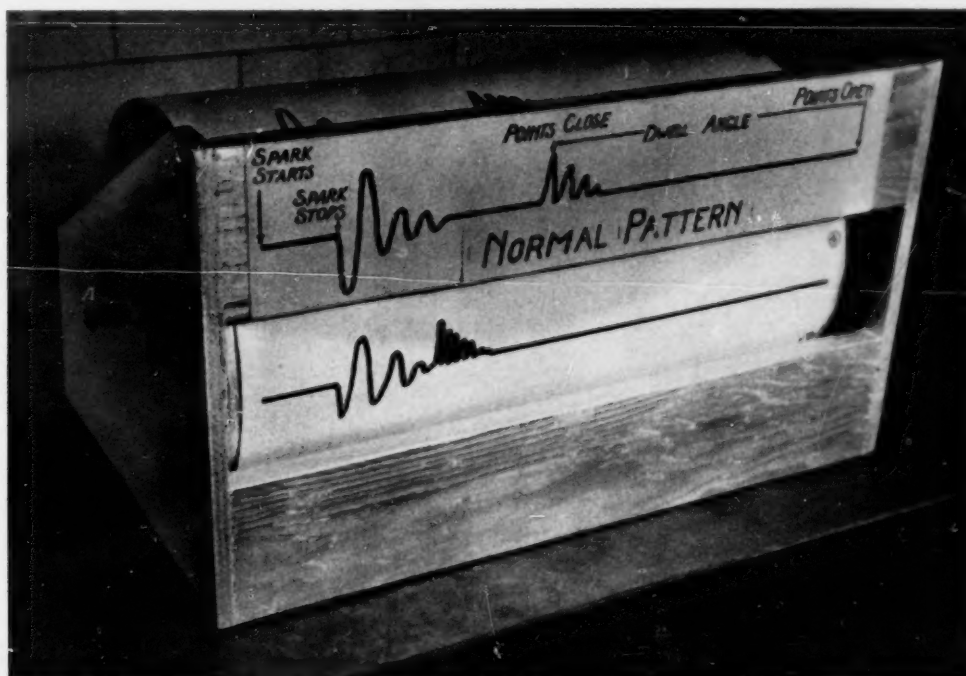
POWER WINDOW CUTAWAY

The unit is battery powered and the working mechanisms can be easily observed. Casters can be mounted and the device can be shared by the auto mechanics and auto body repairs programs.

Fred Thompson

Arsenal Technical H. S.

Indianapolis, Indiana



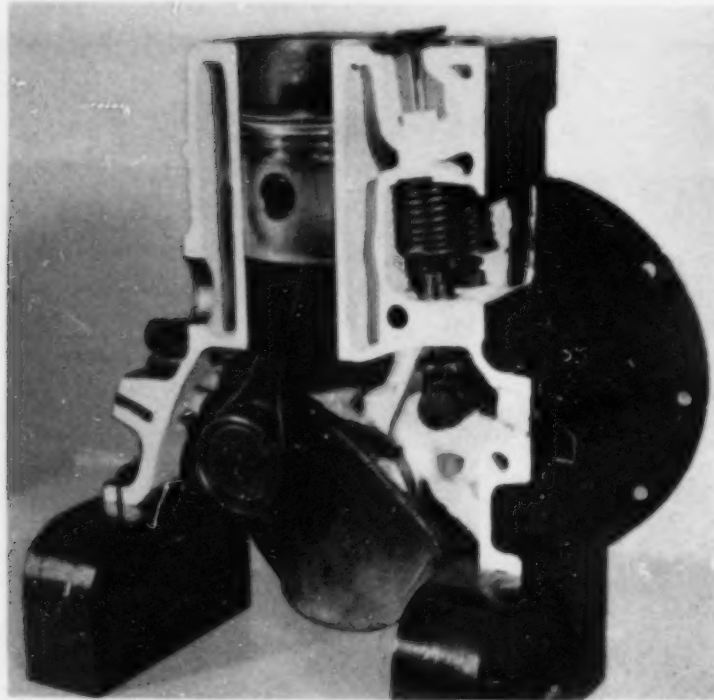
OSCILLOSCOPE PATTERN MOCK-UP

This aid demonstrates the use of the oscilloscope in motor tune-up.

William Terrett

Max S. Hayes Trade School

Cleveland, Ohio

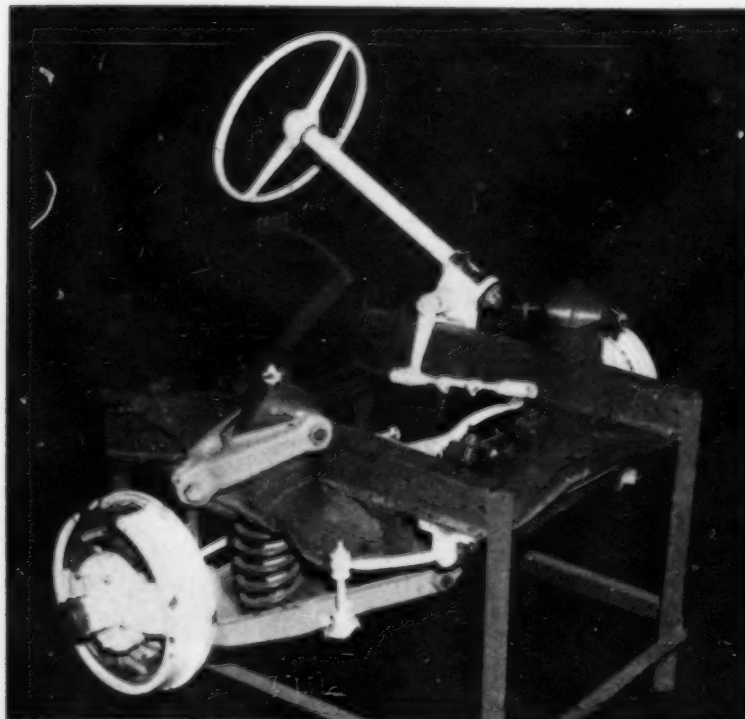
AUTO MECHANICS**SECTIONAL ENGINE CUTAWAY**

This aid is used in teaching the names, correct terminology, relationship, and operation of the various components of the internal combustion engine.

J. A. Gutenson

Reavis High School

Oak Lawn, Illinois

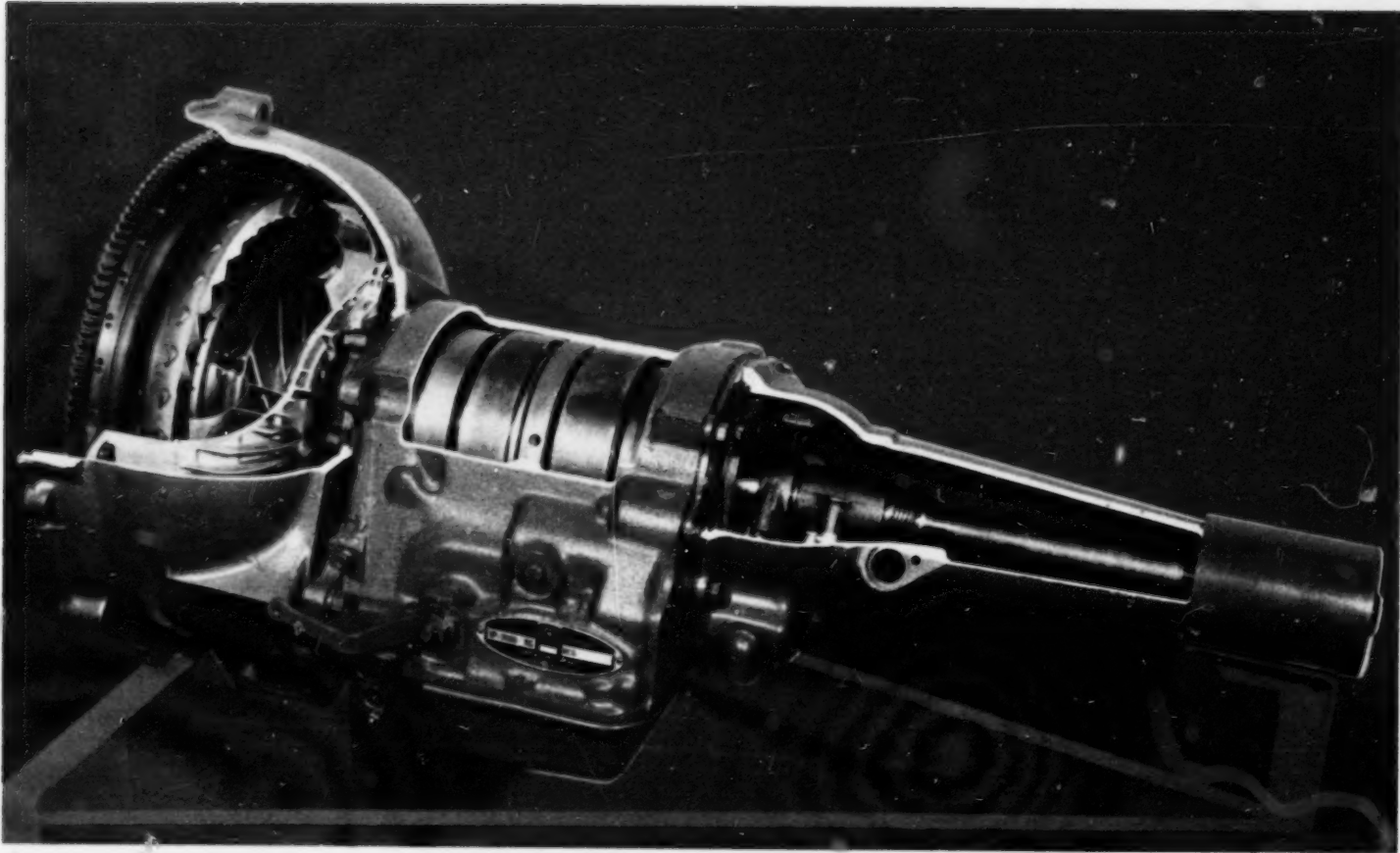
**FRONT END SYSTEM**

This working model illustrates the operational features of the front end and brake system of an automobile.

Fred Thompson

Arsenal Technical H. S.

Indianapolis, Indiana



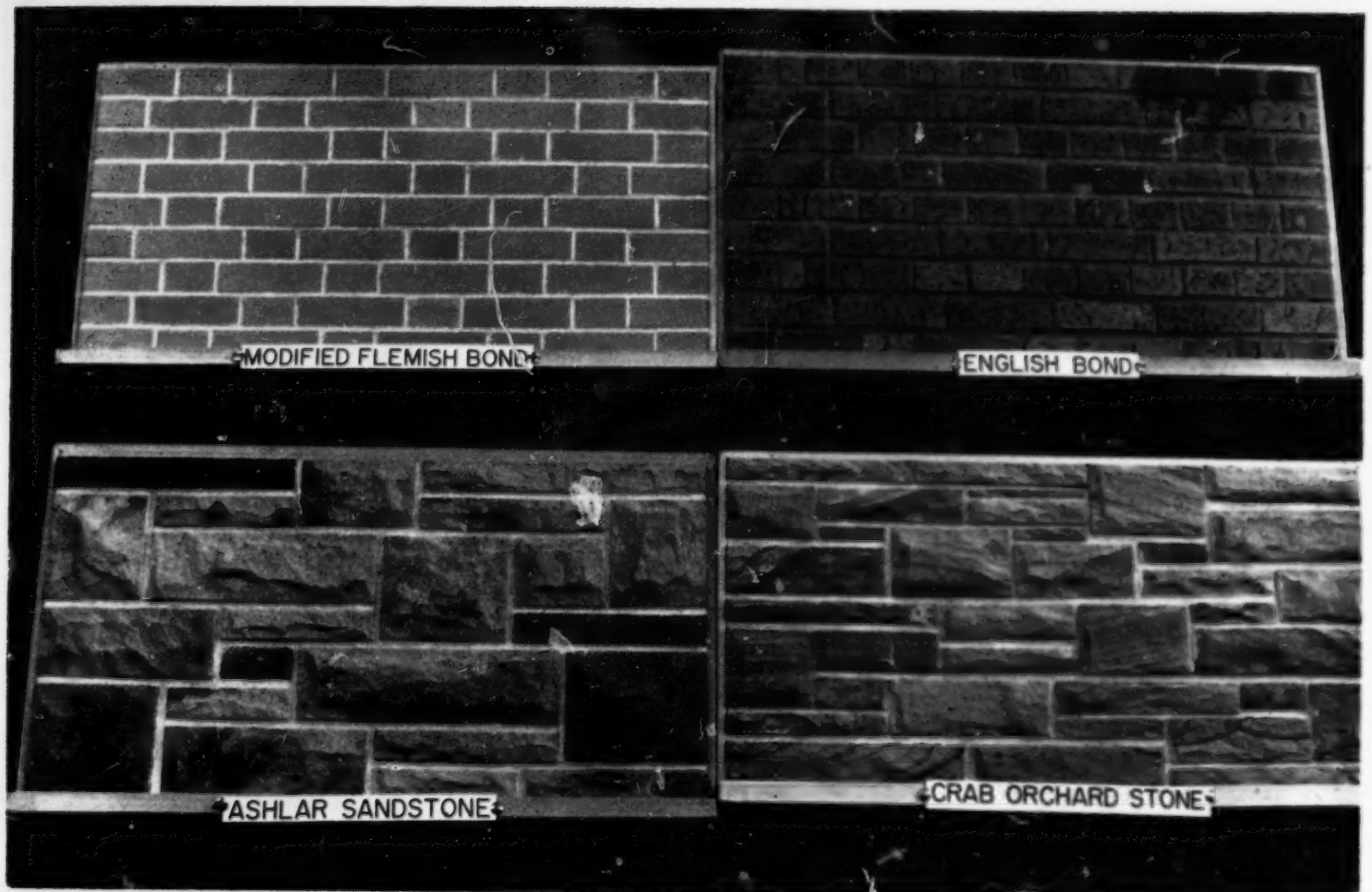
AUTOMATIC TRANSMISSION CUTAWAY

This portable unit is used both in the auto shop and in the related classroom. The transmission is manually revolved and the principles and correct nomenclature are quickly grasped.

J. A. Gutenson

Reavis High School

Oak Lawn, Illinois



BONDS AND TYPES

These panels show a few of the different types of bonds and variations of stones that are used in exterior masonry.

Harold Kuhfeld

Max S. Hayes Trade School

Cleveland, Ohio



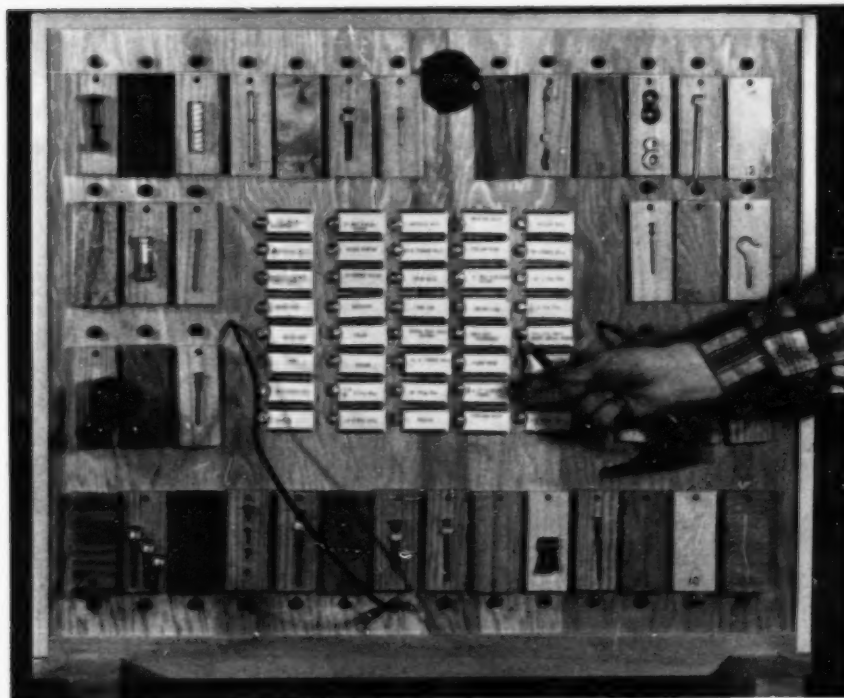
SAMPLE JOINTS—DISPLAY BOARD

This teaching aid demonstrates the construction of the commonly used joints. Parts of the joints are shown in each instance along with the assembled joint.

Ralph Evans

Topeka Public Schools

Topeka, Kansas



TESTING MACHINE

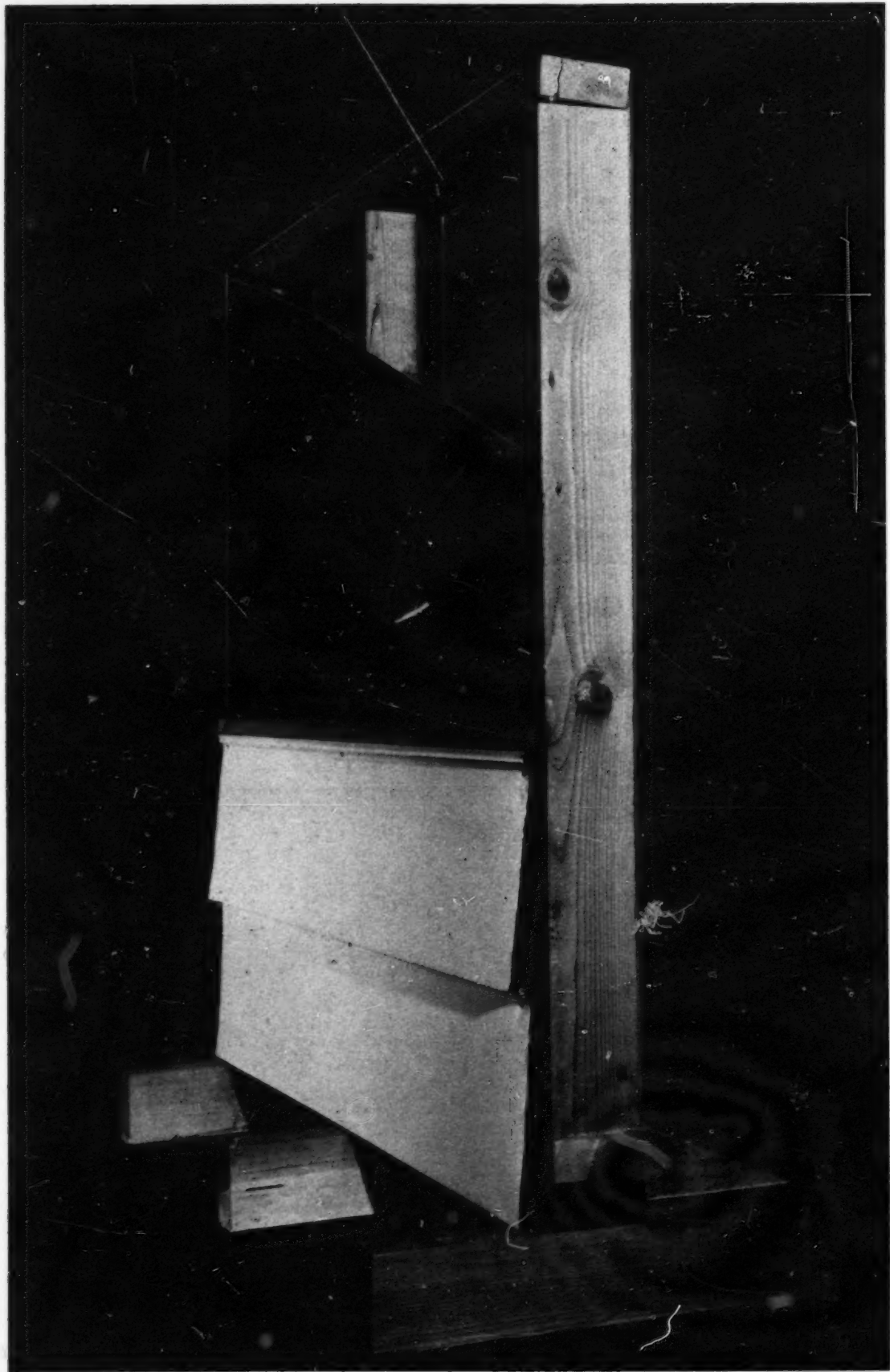
This testing machine may be used by students to test their knowledge of woods and nomenclature of tools and fastening devices used by the cabinet maker in constructing cabinets

and furniture. The answers and test items are wired so that the light flashes when the wire terminals are correctly matched.

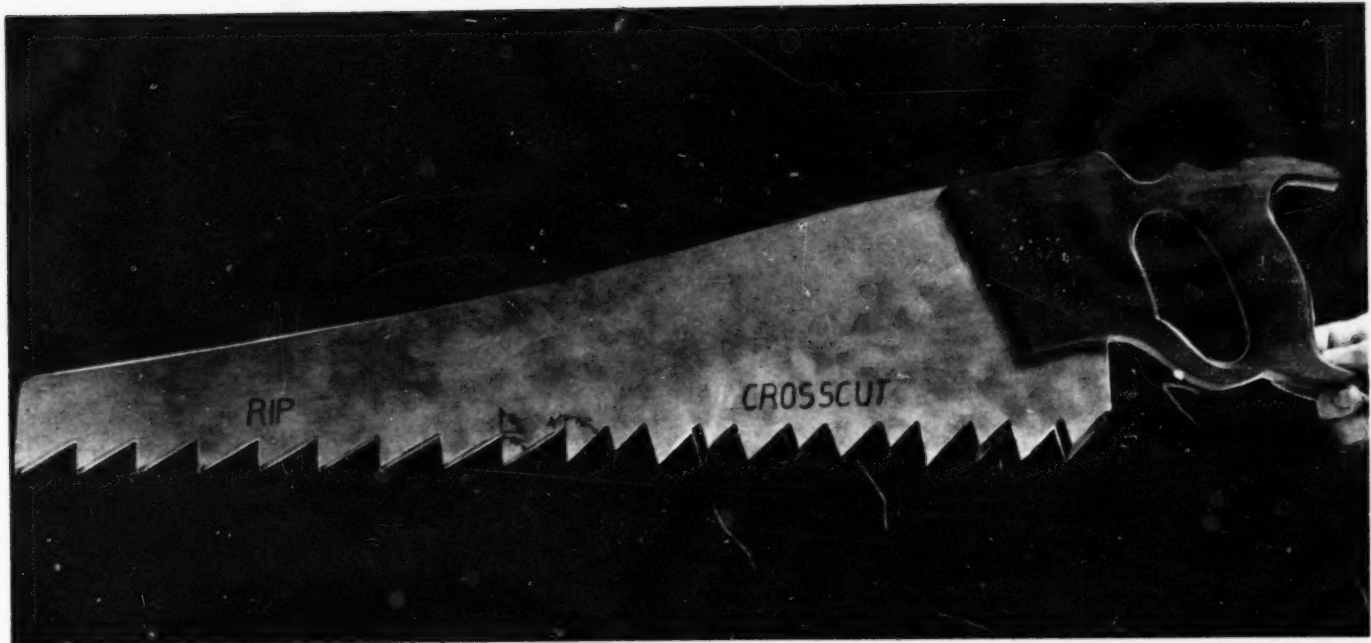
Harold J. Gregg

Wichita Public Schools

Wichita, Kansas

**EXTERIOR WALL MOCK-UP**

This aid enables the teacher to demonstrate the elements that comprise wall construction.
The application of aluminum siding was featured in this aid.



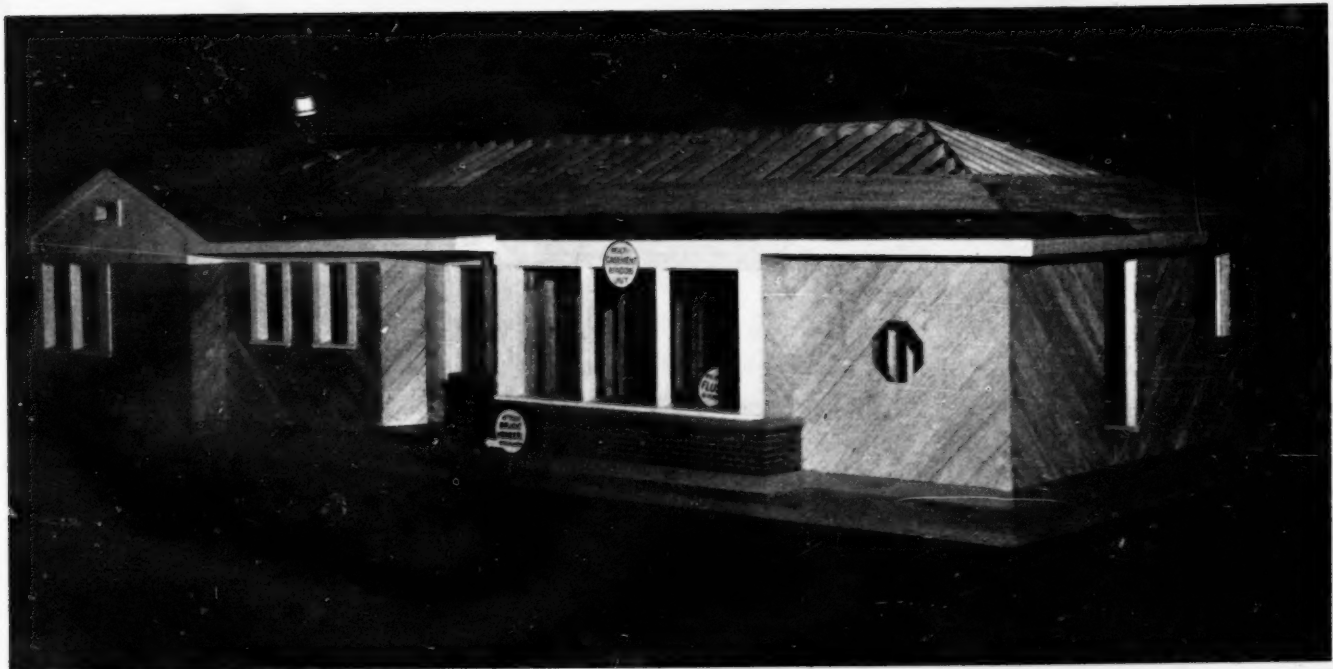
HAND SAW MODEL

This enlarged model of a hand saw is used to teach the difference between "Rip" and "Cross cut" teeth.

Robert Lehr

Wichita Public Schools

Wichita, Kansas



MODEL HOME CONSTRUCTION

Operations needed in home construction are better understood when their application can be clearly demonstrated. Motivation is increased when the finished product is exhibited.

This model embodies many of the operations common to home construction. Each part is labeled. Part of the con-

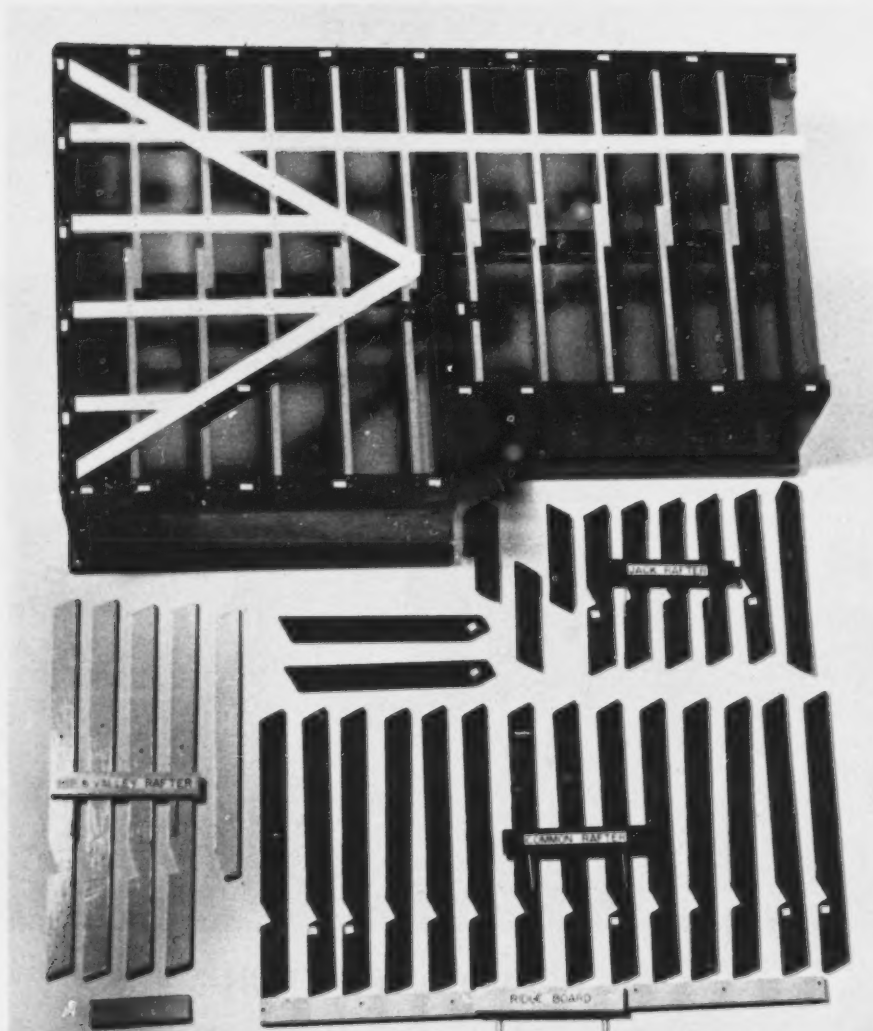
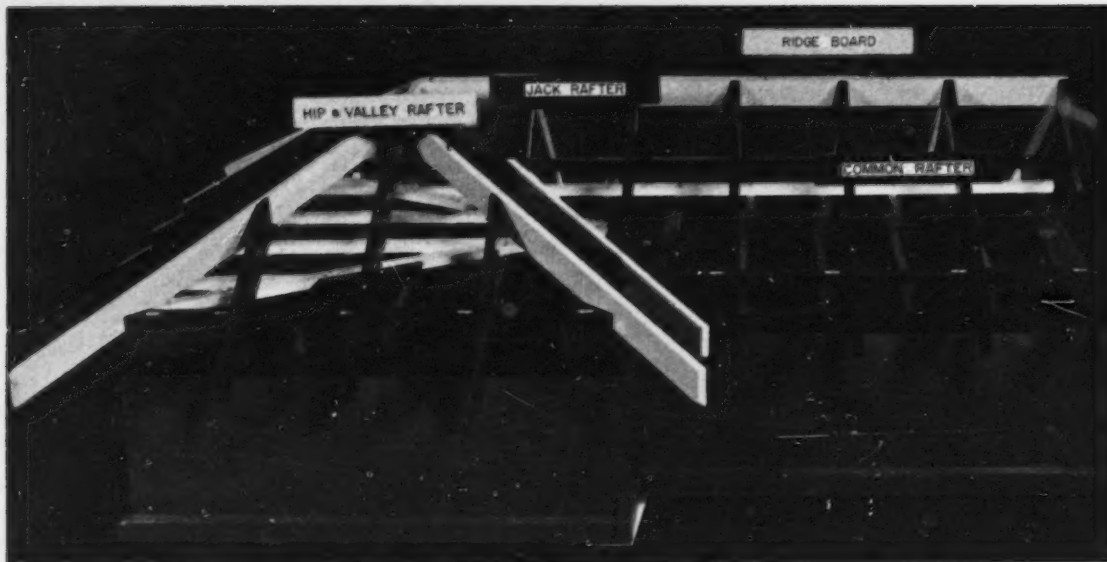
struction is left open and unfinished so that students may observe cross-sections and structures beneath.

It serves a good purpose for overall orientation to building construction and enables the use of less complex aids to teach the individual operations of the trade.

Charles Pritchett

Somerset Vocational School

Somerset, Kentucky



ROOF FRAMING MODEL

This teaching aid may be used to demonstrate the various rafter cuts and the principles of roof construction. The roof section may be disassembled and reassembled during a

Jon Grove

demonstration so that attention may be directed to specific details. The use of color coding and name plates helps in the teaching of correct nomenclature.

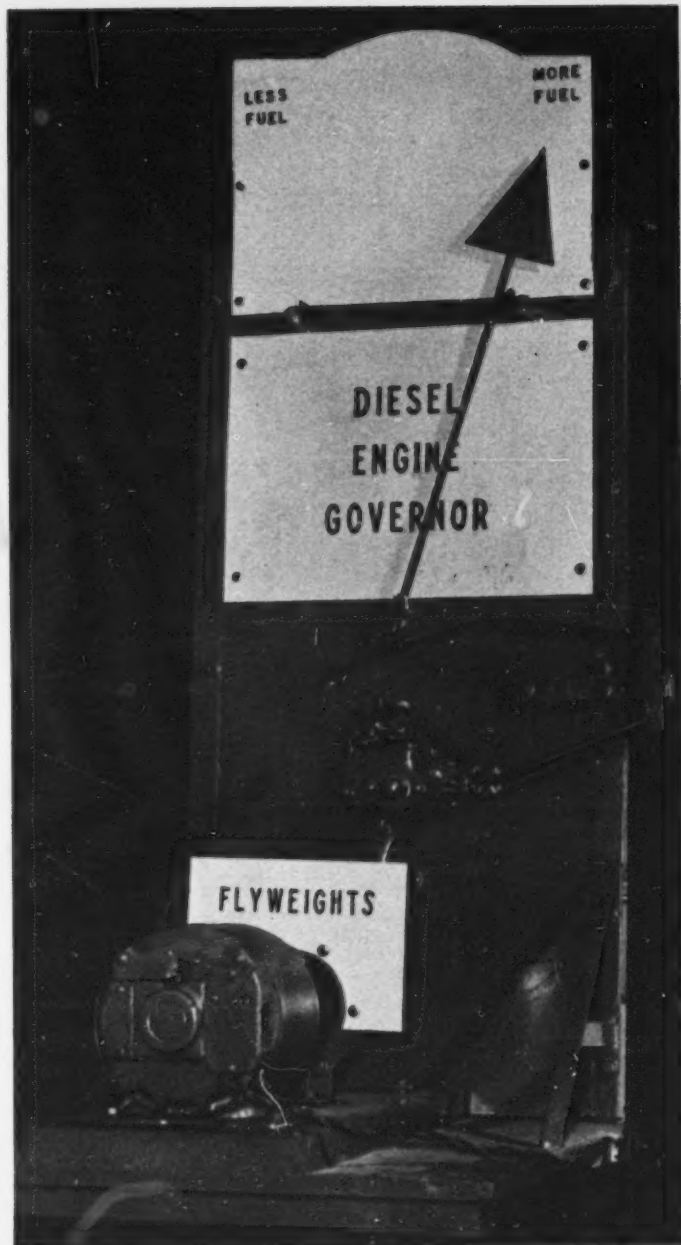
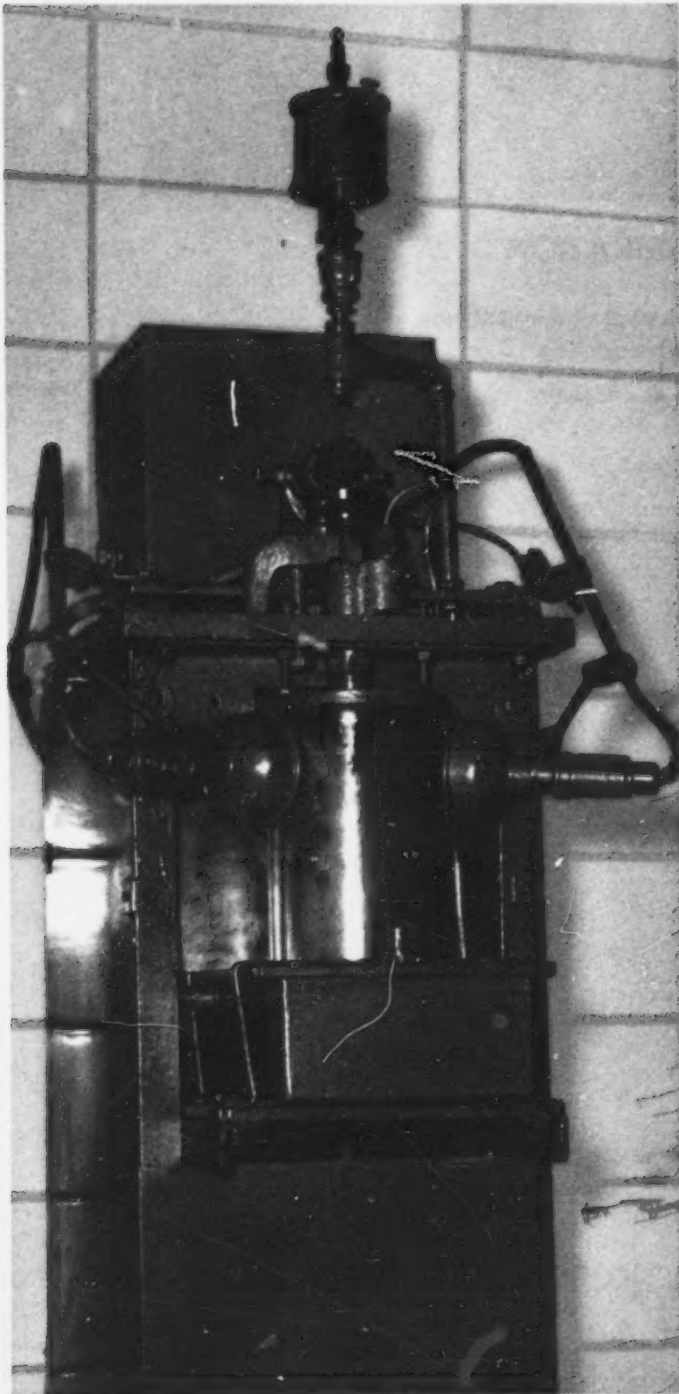
Kansas State College of Pittsburg

Pittsburg, Kansas

DIESEL ENGINE GOVERNOR

A change in speed of the electric motor is accompanied by a corresponding increase or decrease in the centrifugal force developed by the rotating governor fly-weights. The reaction of the governor spring controls the amount of fuel injected into the cylinders of the engine.

Milwaukee Vocational and Adult Education School
Milwaukee, Wisconsin

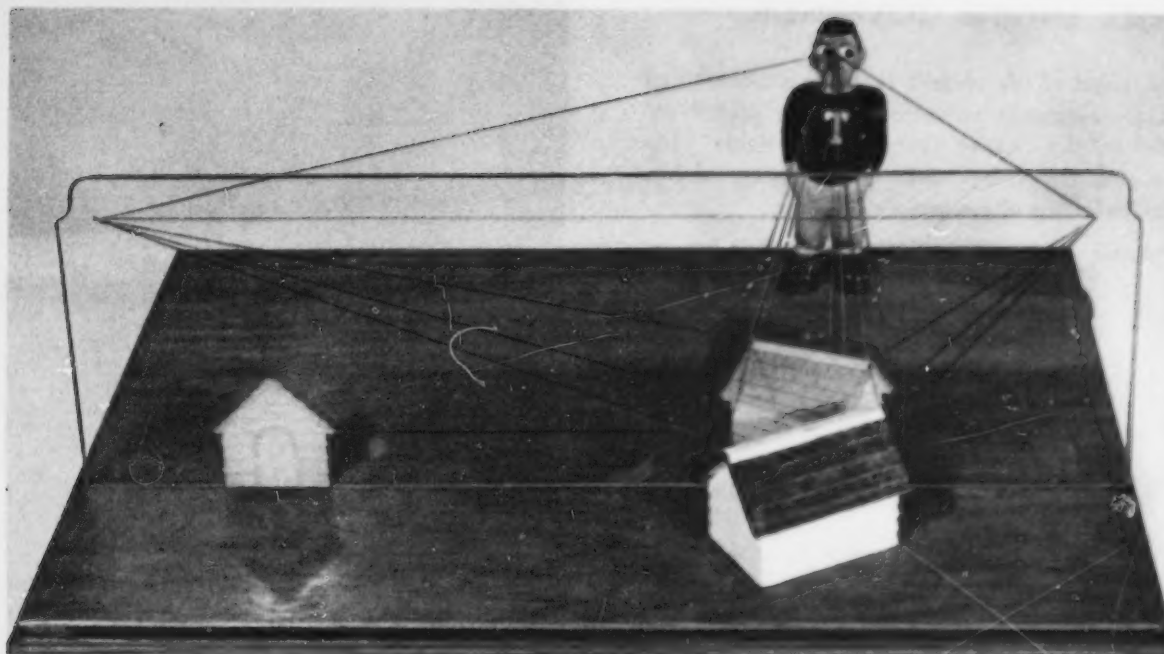


DIESEL ENGINE UNIT INJECTOR

This exhibit shows the pattern of the fuel oil spray delivered by a unit type of injector. The injector is "popped" by a cam acting against the injector follower. The mechanism is motor driven and has a constant fuel oil return to the reservoir.

Milwaukee Vocational and Adult Education School
Milwaukee, Wisconsin





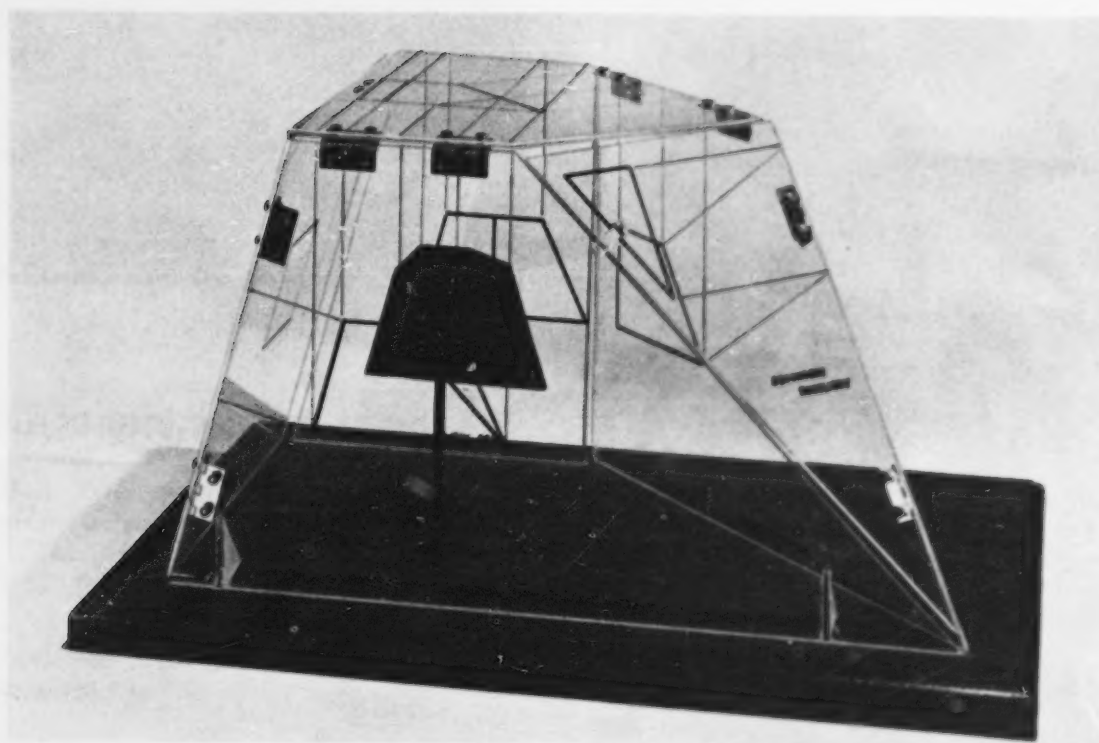
PERSPECTIVE ILLUSTRATION

Device for showing the relationship of the vanishing points with a perspective drawing.

J. F. Holt

Kansas State College of Pittsburg

Pittsburg, Kansas



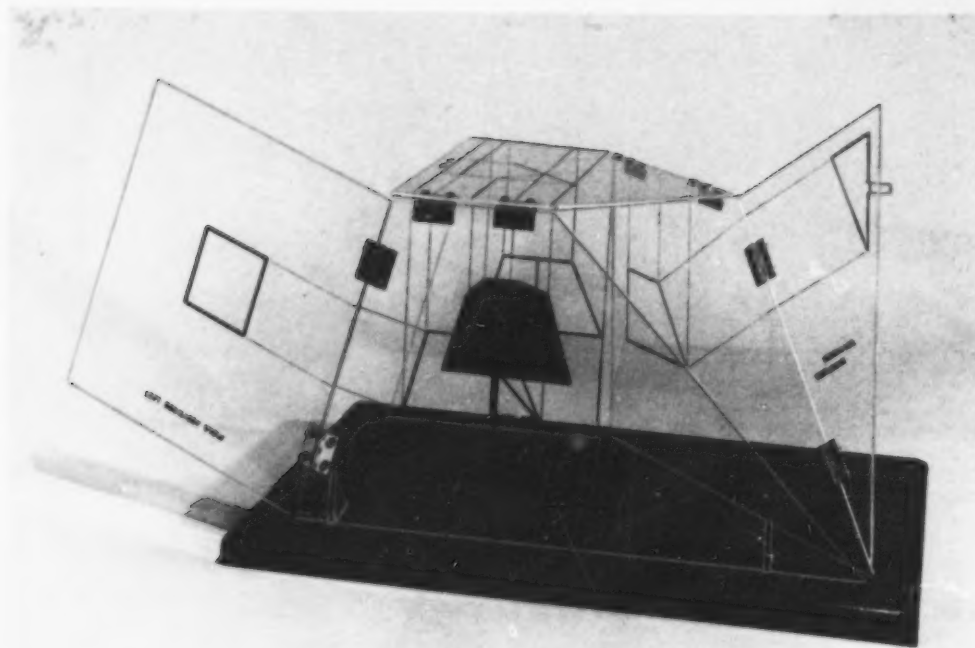
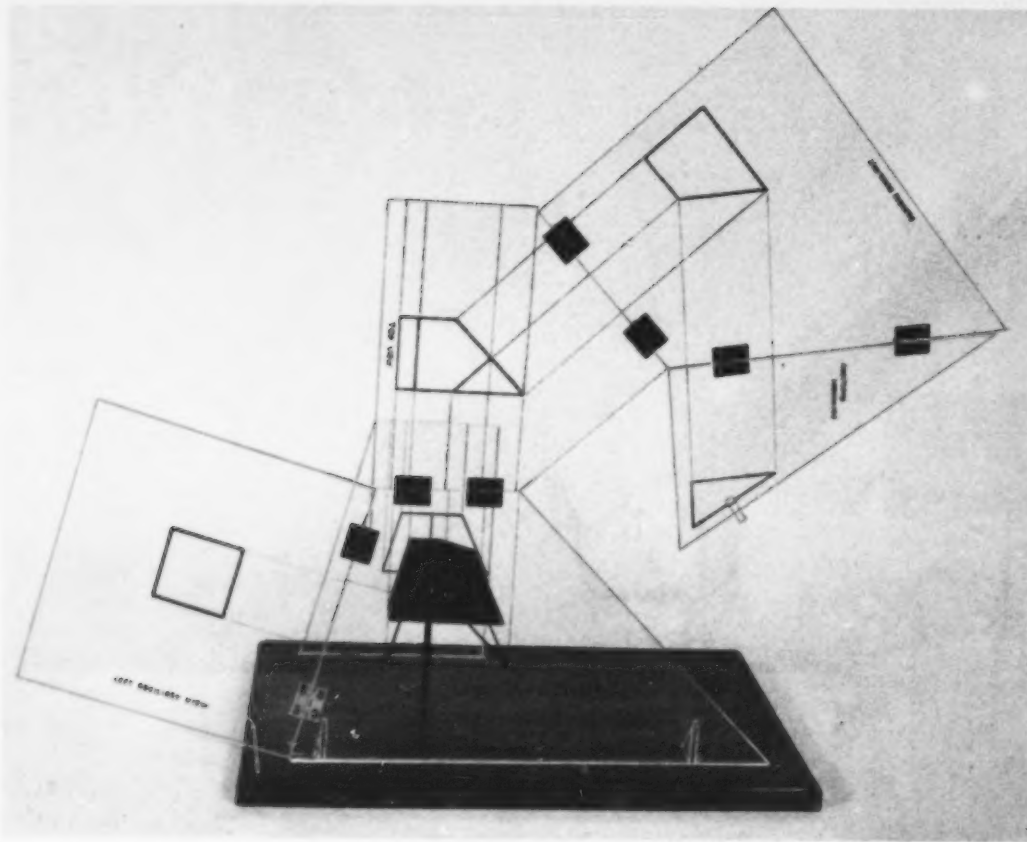
AUXILIARY VIEW PROJECTION BOX

This visual aid is used in demonstrating the relationship between auxiliary views and the principal views in orthographic projection, as it is used in mechanical drafting.

Milwaukee Vocational and Adult Education School

It consists of a box made from transparent plastic, the sides of which have the same relationships and slopes as the faces of a wooden model fastened inside the box.

Milwaukee, Wisconsin



AUXILIARY VIEW PROJECTION BOX

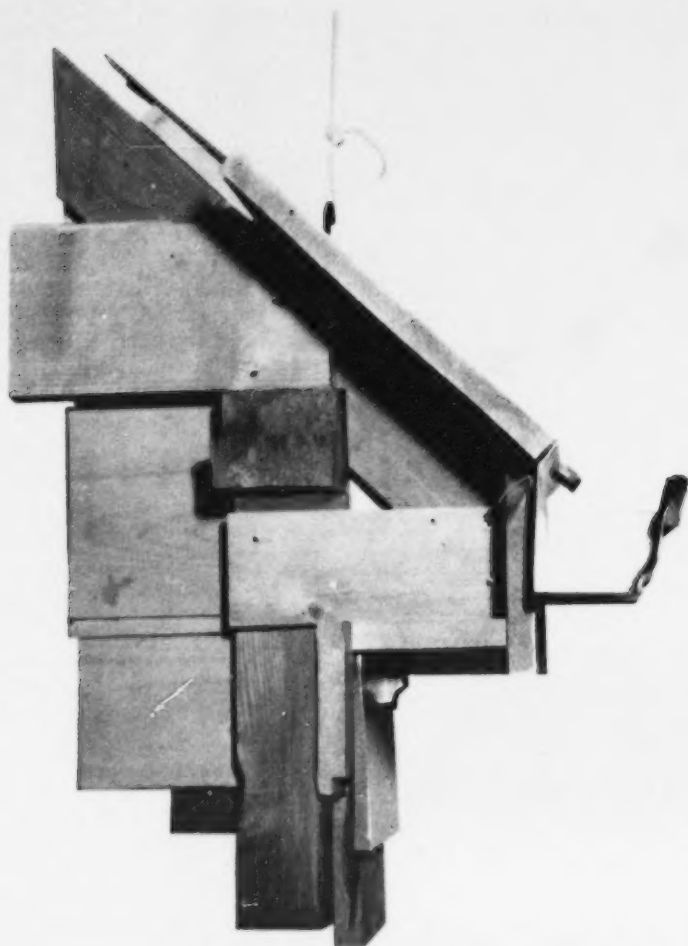
The top plane and the left auxiliary plane are hinged to the front plane. The right auxiliary is hinged to the top plane and the secondary auxiliary plane is hinged to the right auxiliary plane. On all planes, the respective views are drawn together with the projection lines to tie them together. When all of the hinged sides of the box are

Milwaukee Vocational and Adult Education School

unfolded, the front and top views together with the left and right auxiliary views and a second auxiliary view are shown in one plane.

The front and rear faces are permanently fastened to the wooden base for rigidity.

Milwaukee, Wisconsin



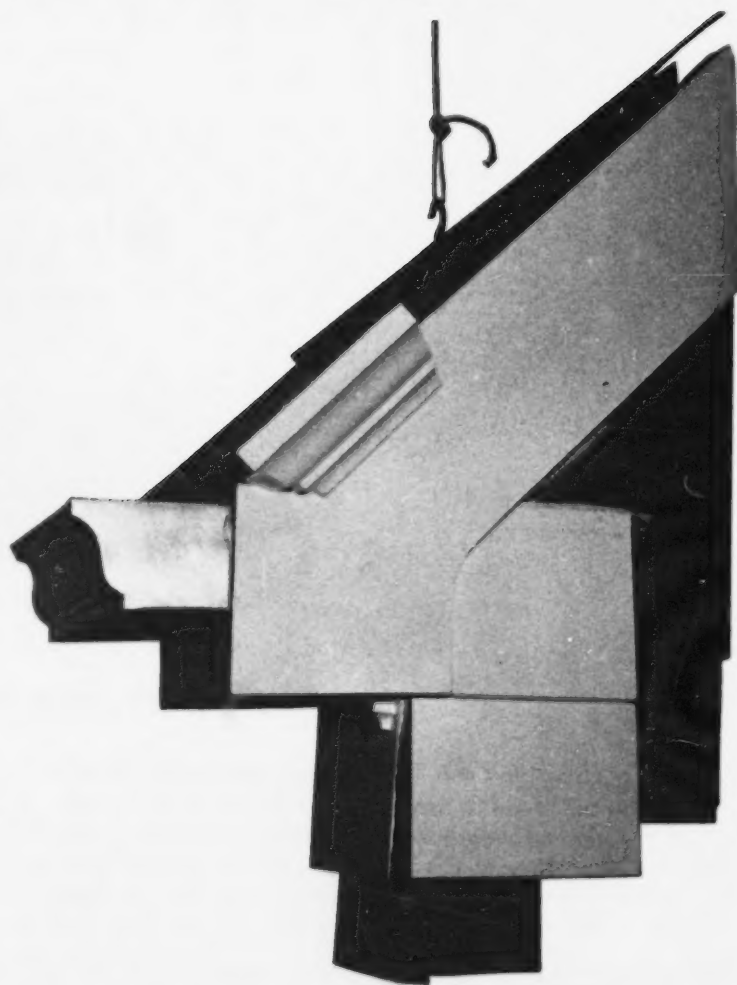
MODEL BOX CORNICE

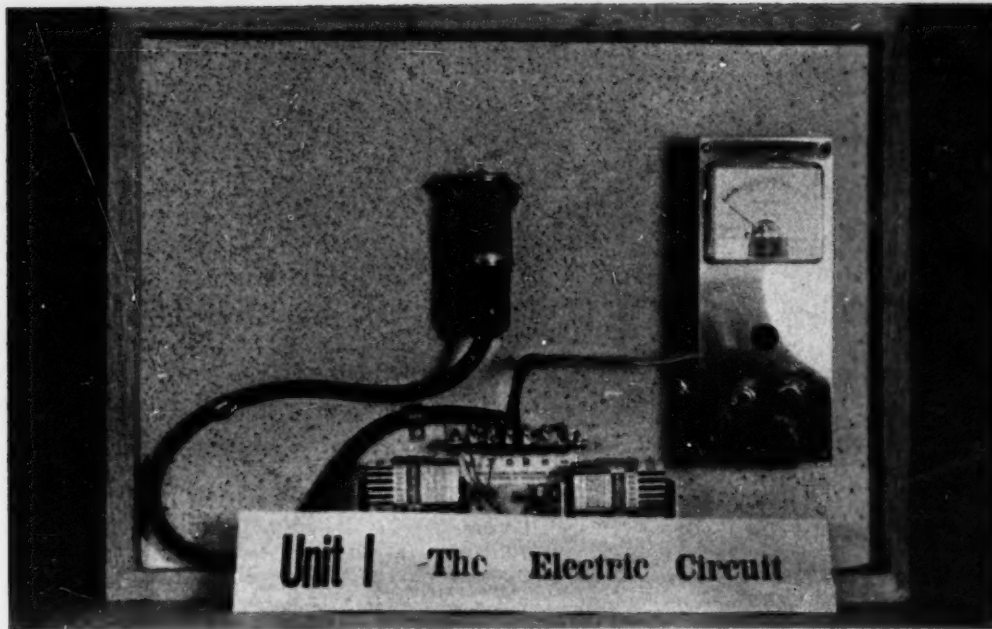
Carpentry and architectural drafting classes have made frequent use of this full size box cornice. It reveals the typical construction elements that are usually noted in frame home building.

Conrad L. Mattson

Sleepy Eye High School

Sleepy Eye, Minnesota





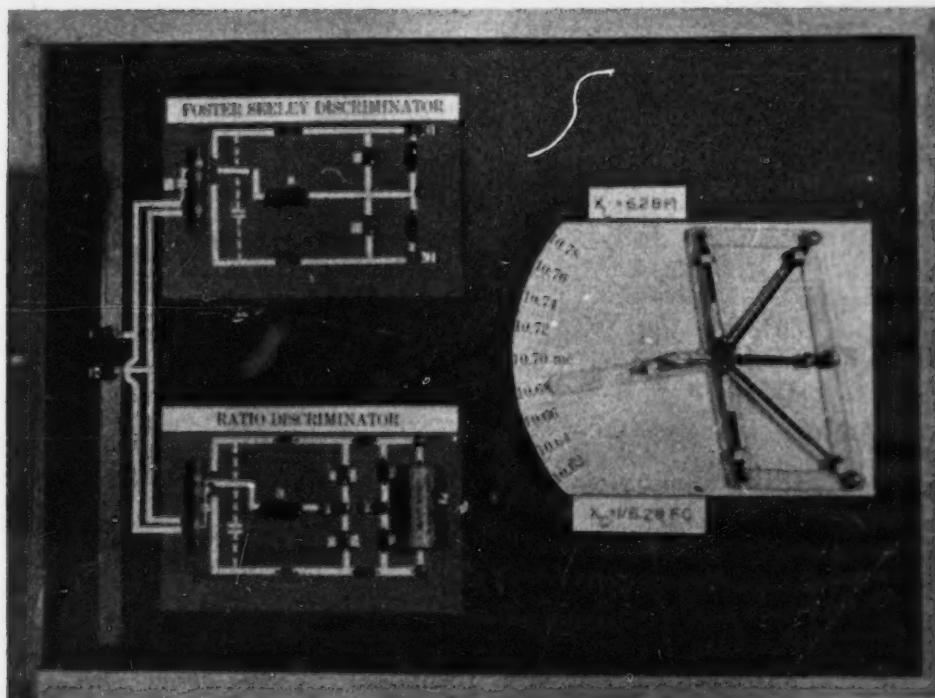
ELECTRIC CIRCUIT DEMONSTRATOR

The fuel vapor detector circuit shown is used as a demonstrator of detector circuitry for use in classes in Industrial Electronics, and Automation.

William Kavanaugh

University of Minnesota

Minneapolis, Minnesota



F.M. DISCRIMINATORS

The F.M. discriminator demonstrator was planned to demonstrate the two common F.M. detector circuits—the panel can be plugged into an F.M. receiver front end and both kinds of detector action shown.

The moving vector arrows on the right side of the panel are used to show mathematically the vectors involved in the two kinds of detector action.

William Kavanaugh

University of Minnesota

Minneapolis, Minnesota

5993710-61-4



OHMS LAW

This teaching aid is a help in teaching students the three basic formulas in the teaching of Ohms Law. The four sides of the model represent the relationships between "E" voltage; "I" ampere; and "R" resistance. The area painted black in each case represents the unknown in the formula.

Paul D. Conrad

Wichita Public Schools

Wichita, Kansas

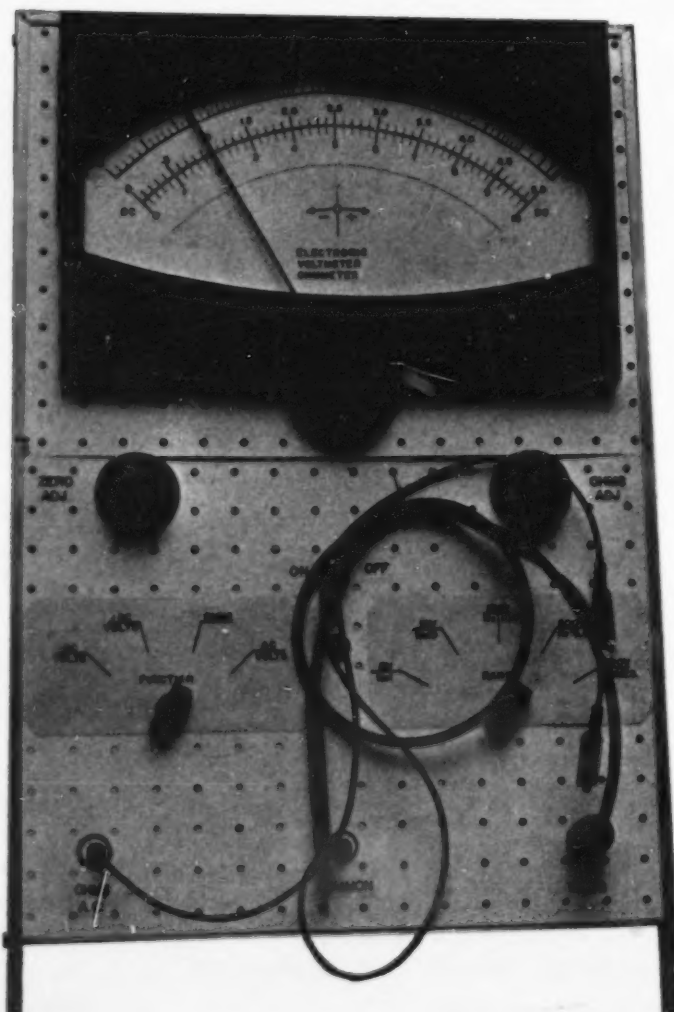


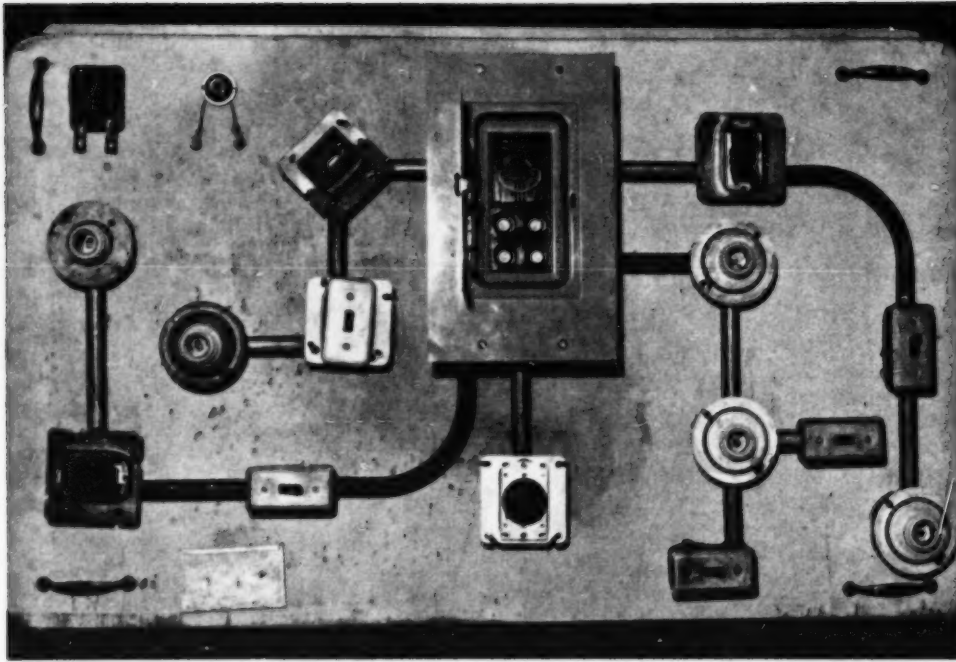
VOLTMETER MOCK-UP

This ring-size voltmeter involves the common properties of all such meters and is used for initial instruction in meters. It greatly assists in teaching meter connection, scale reading, and meter safety. The attention of a group of students is focused simultaneously on a class-size mock-up.

Ahrens Trade School

Louisville, Kentucky





ELECTRIC WIRING BOARD

The different types of wiring devices including a three-wire electric range outlet, etc., bell transformer, pushbutton and bell or buzzer are included in this aid.

On this board a student can wire a typical house system,
East Leyden H. S.

with various types of switches. It enables him to observe the connection of circuits between neutral and hot wires and to range circuits, etc.

Franklin Park, Illinois



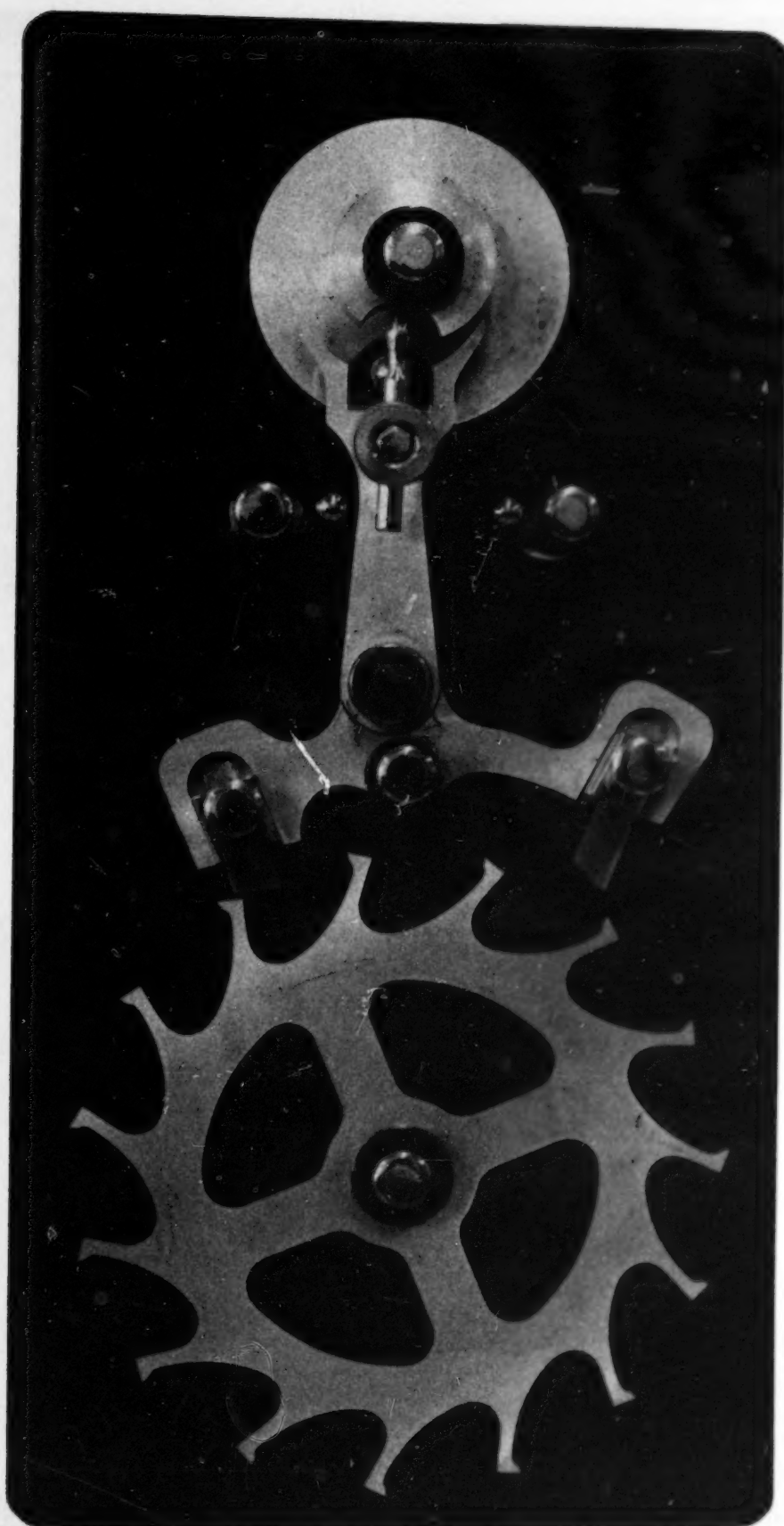
SYNCHRO-GENERATOR AND RECEIVER

This model assists students in the understanding of the principles of servomechanisms. It provides means of demonstrating the effect of reversed connections to servo units.

Ronald Holman

Stout State College

Menomonie, Wisconsin



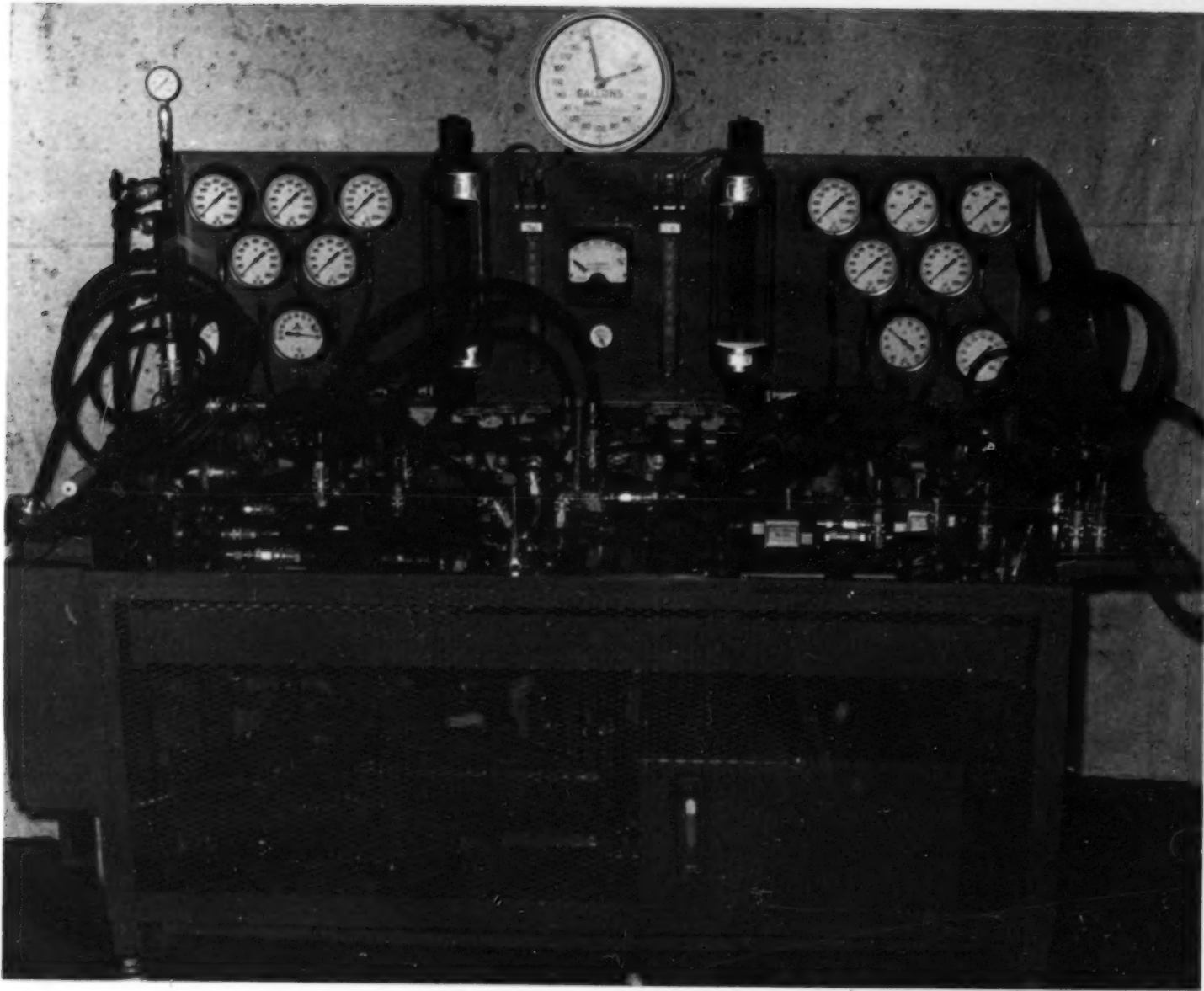
ESCAPEMENT MECHANISM

This large scale model was designed to show the working principles of the escapement mechanism of a watch.

Joseph A. Brown

Max S. Hayes Trade School

Cleveland, Ohio



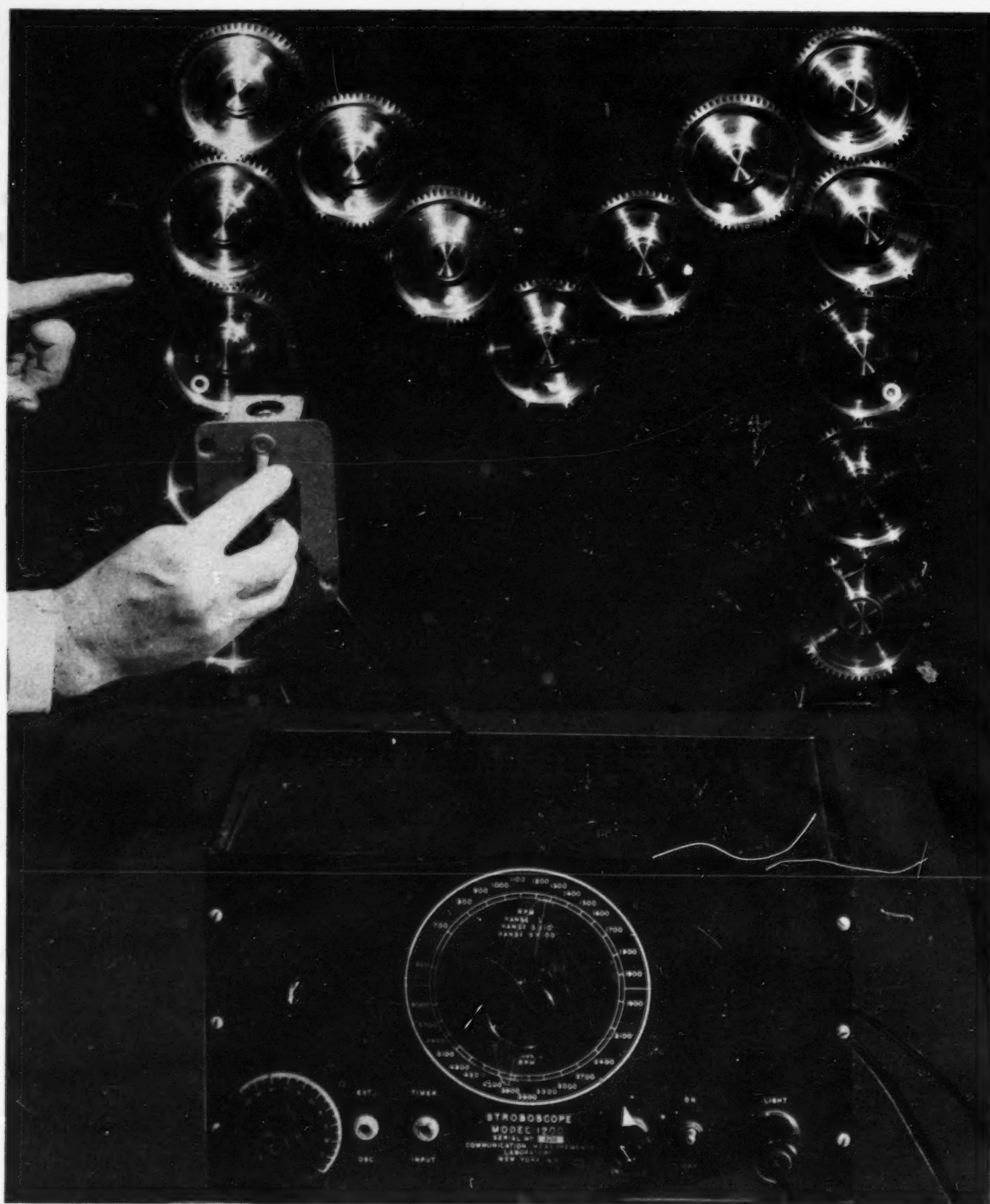
HYDRAULIC COMPONENT TEST STAND

This stand is used to study the flow characteristics of various types of hydraulic valves including volume control, pressure

control and directional control valves. The stand is also used to build up various types of hydraulic circuits.

Milwaukee Vocational and Adult Education School

Milwaukee, Wisconsin



GEAR TRAIN

This mock-up is used to point out the functional value of an individual part (gear) and its relationship to an assembly. The stroboscope is shown in use checking the accuracy of the milling machine indexing. In like manner, center dis-

tance, clearance, working depth, pressure angle, and other gear tooth allowances and tolerances may be shown or demonstrated.

Kenneth Harr

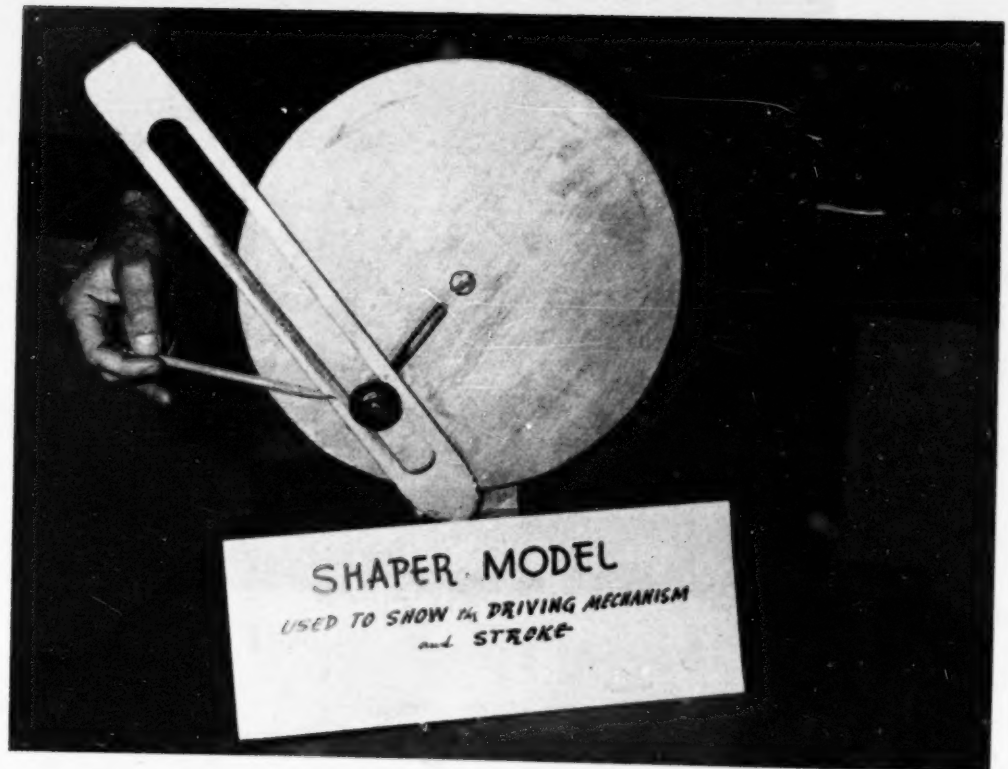
Bellefontaine High School

Bellefontaine, Ohio

SHAPER MODEL

The shaper mock-up provides an opportunity to demonstrate the driving mechanism of a machine shop shaper. In addition, the principle of changing from a rotary to a reciprocating motion can be shown. This mock-up permits the length of the stroke to be varied, thereby making it a valuable machine shop teaching aid.

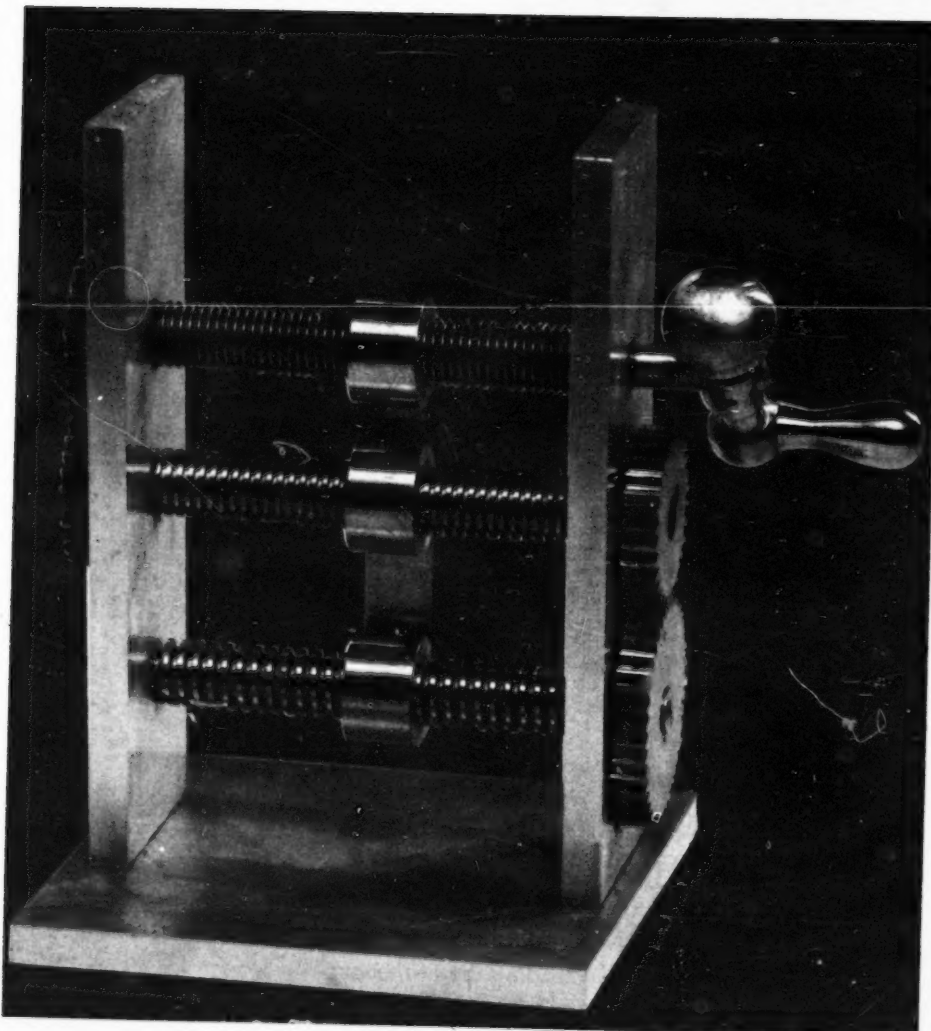
Kenneth Harr
Bellefontaine High School
Bellefontaine, Ohio



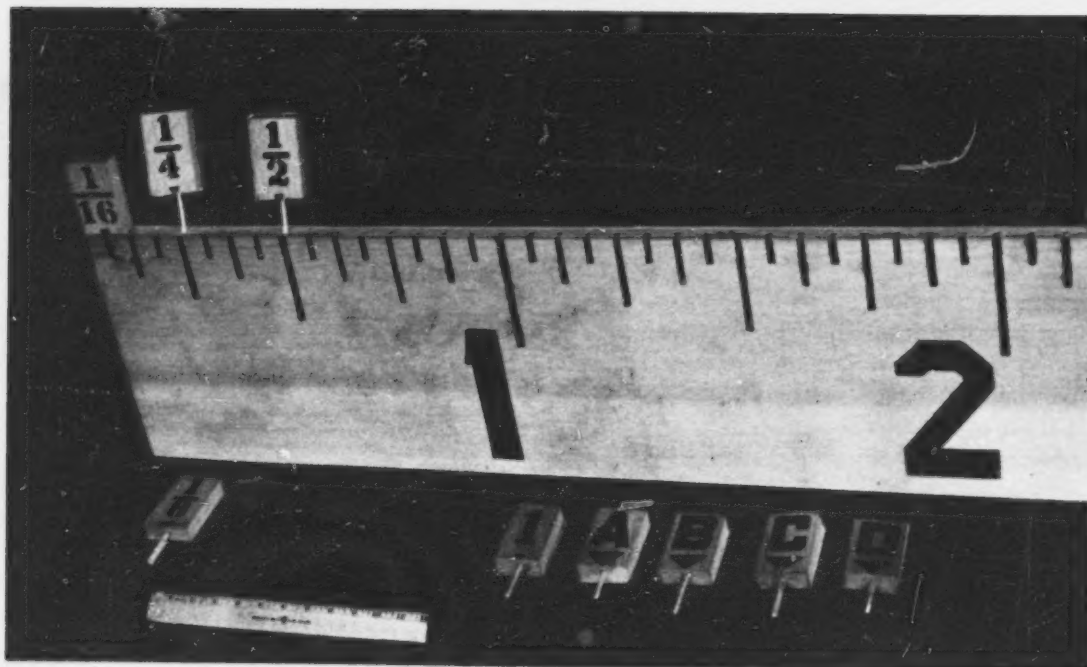
THREAD DEMONSTRATOR

This demonstrator unit involving national coarse, square, and acme threads, gears and a lever provides material for many interesting lessons. The three nuts move uniformly along the shafts as a result of the gear ratios which compensate for the variations in the pitch and lead of the screws. The crank provides a handy means of transmitting motion through the screw to the gears.

George W. Cougher
East High School
Wichita, Kansas



MEASUREMENTS



RULE

This teaching aid is used to introduce the reading of the rule. Students refer to their own rules while teacher demonstrates with the large model. The lettered blocks are

used to give problems i.e., how far is it from A to C, from B to D, etc.

Eugene Lundgrin

Topeka Public Schools

Topeka, Kansas



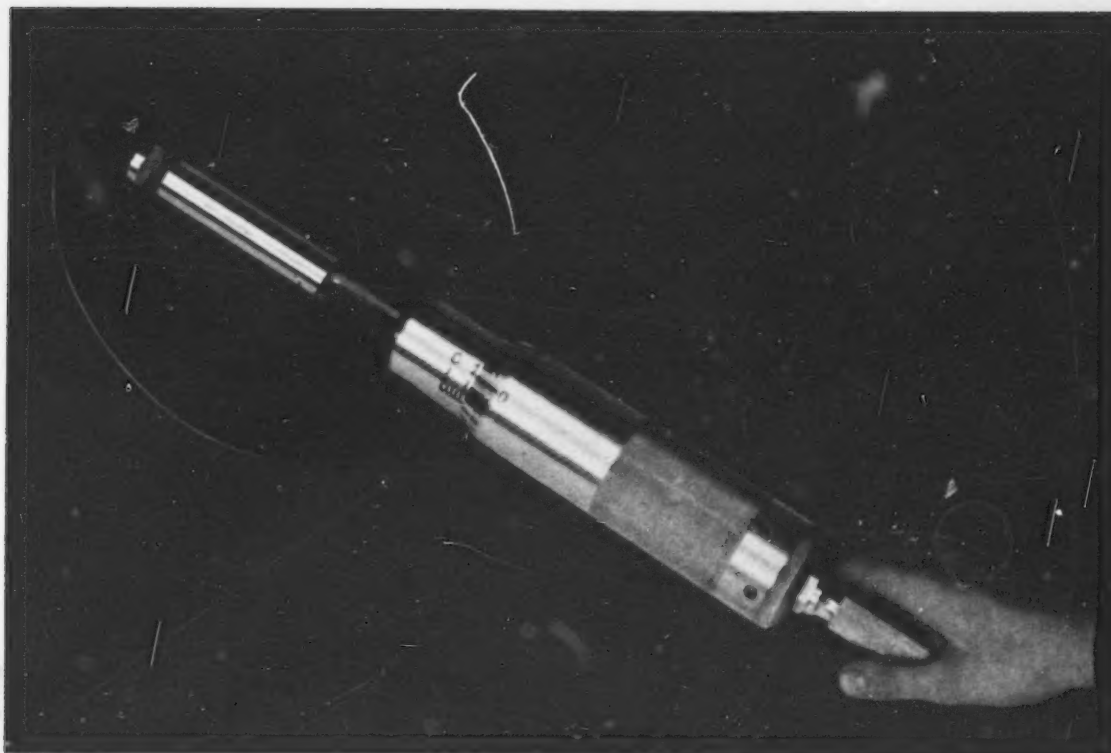
VERNIER CALIPER

This enlarged model of a vernier caliper is used in related math and science courses. It demonstrates the correct method of using and reading the instrument.

F. E. Stewart

Bucyrus City Schools

Bucyrus, Ohio



MICROMETER

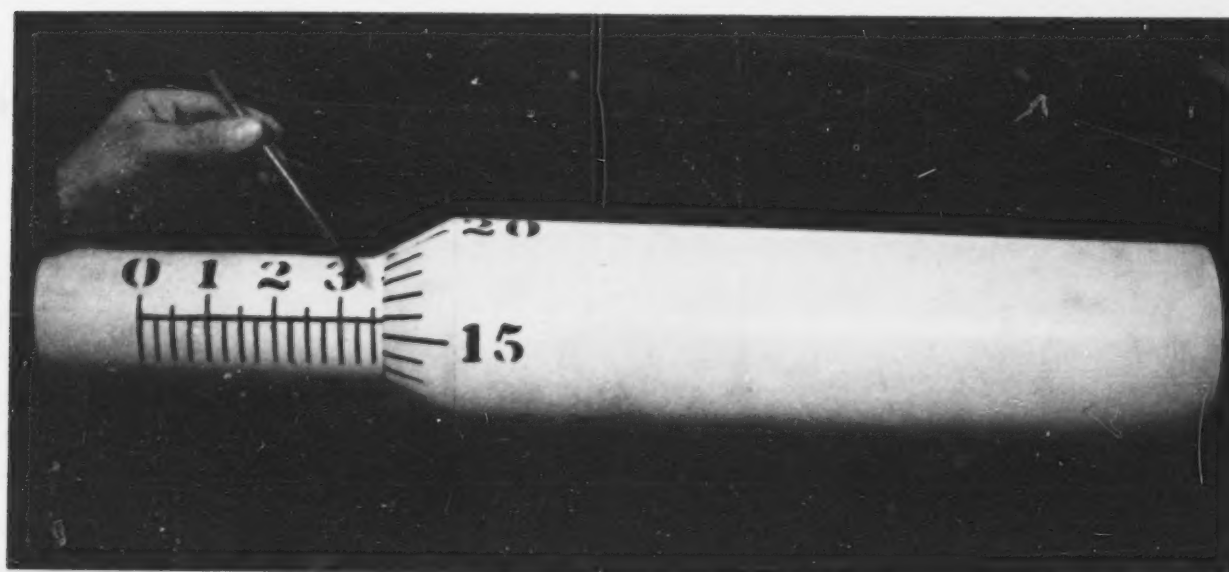
This teaching aid is made of aluminum, scaled five times actual size of 0-1 micrometer, and is reasonably accurate to demonstrate micrometer reading. Pupils may adjust

Leon Le Gresley

their individual micrometers as the teacher demonstrates the readings using this model. Large micrometer is made available to class at all times for practice readings.

Highland Park High School

Topeka, Kansas



CARDBOARD MICROMETER

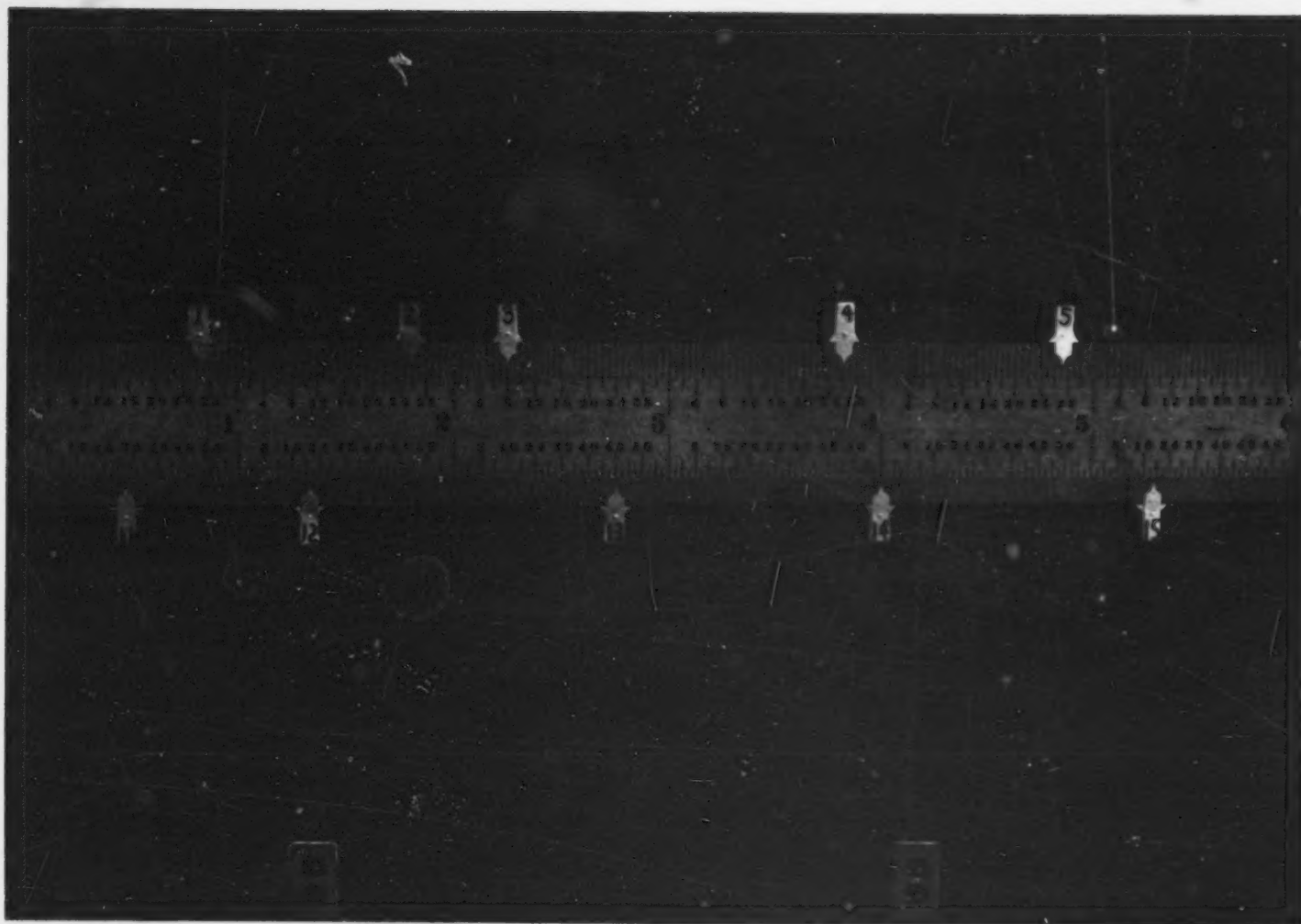
The purpose of this visual aid is to facilitate the teaching of micrometer reading. The large size of the thimble and sleeve, with all of their graduations, makes it readable from any point in a normal-sized classroom.

Richard J. Malone

It gives each pupil the advantage of holding a micrometer and at the same time seeing exactly how to set and read it as the instructor demonstrates on the large model.

Lyons Township H. S. and Jr. College

La Grange, Illinois

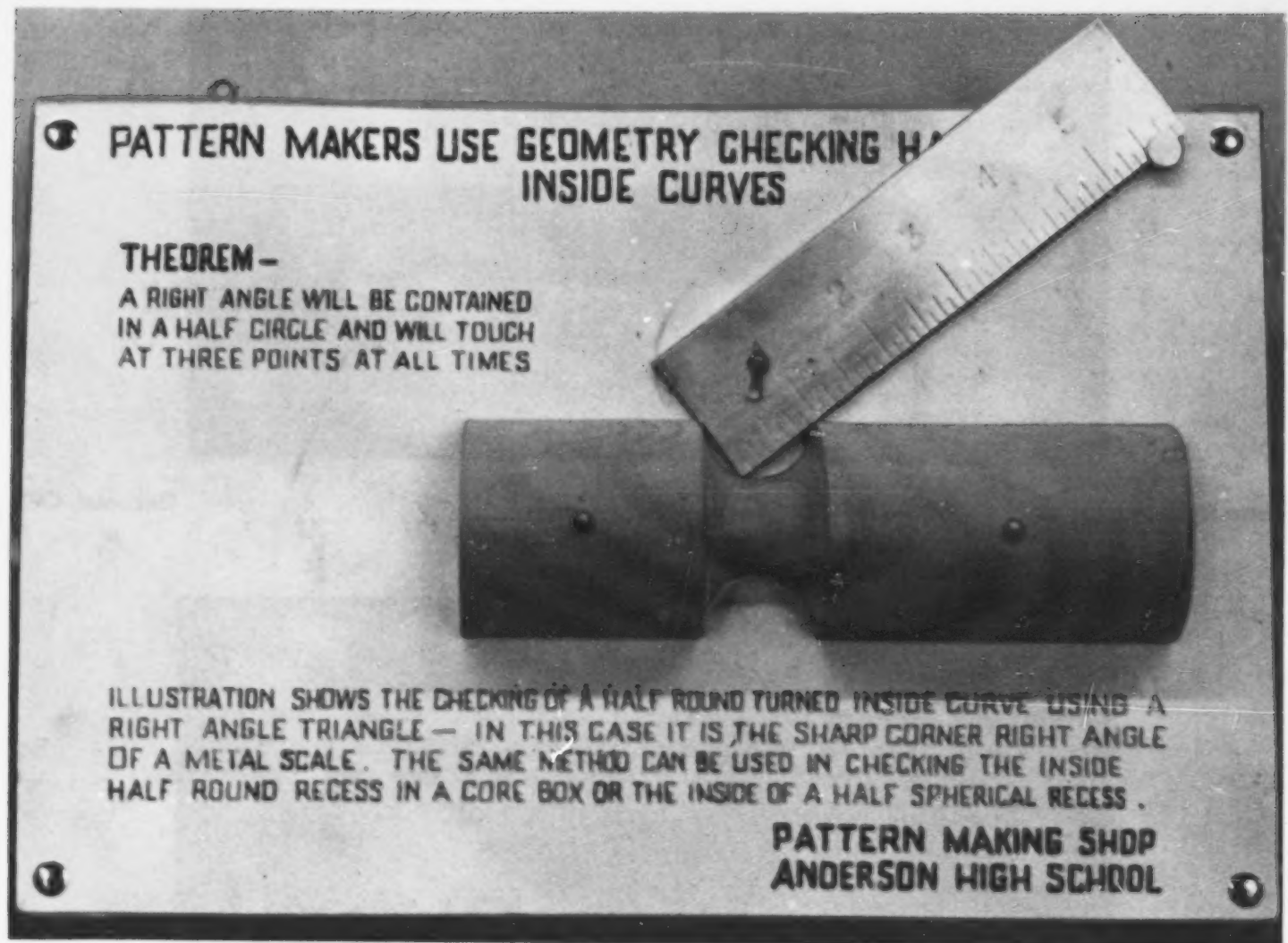


MACHINISTS' RULE

This enlarged rule is used by the instructor for demonstrations. Students are encouraged to practice measuring on his model. The numbered settings are adjustable and are used for testing.

Max S. Hayes Trade School

Cleveland, Ohio



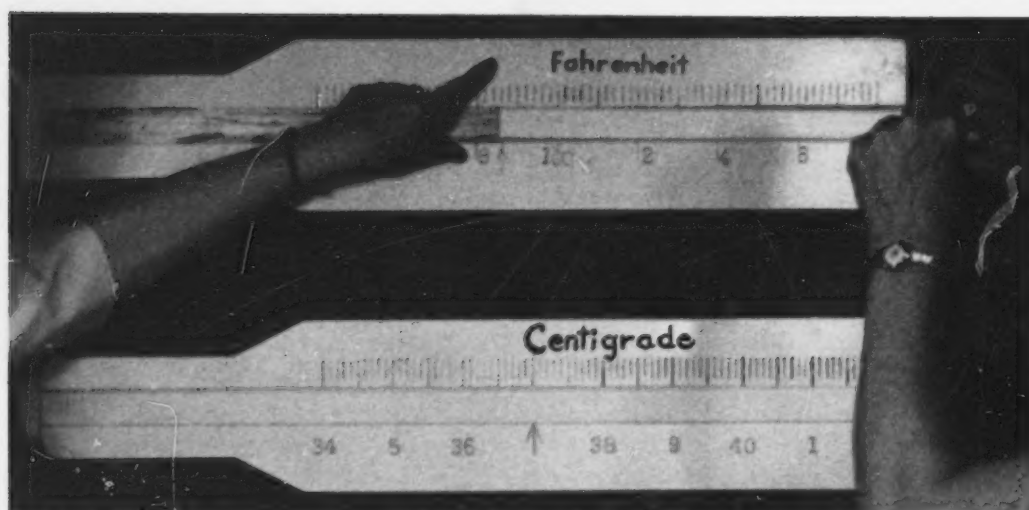
GEOMETRY IN PATTERN MAKING

The model visually proves the theorem that a right angle will be contained in a half circle and will touch at three points simultaneously.

J. L. Hale

Anderson High School

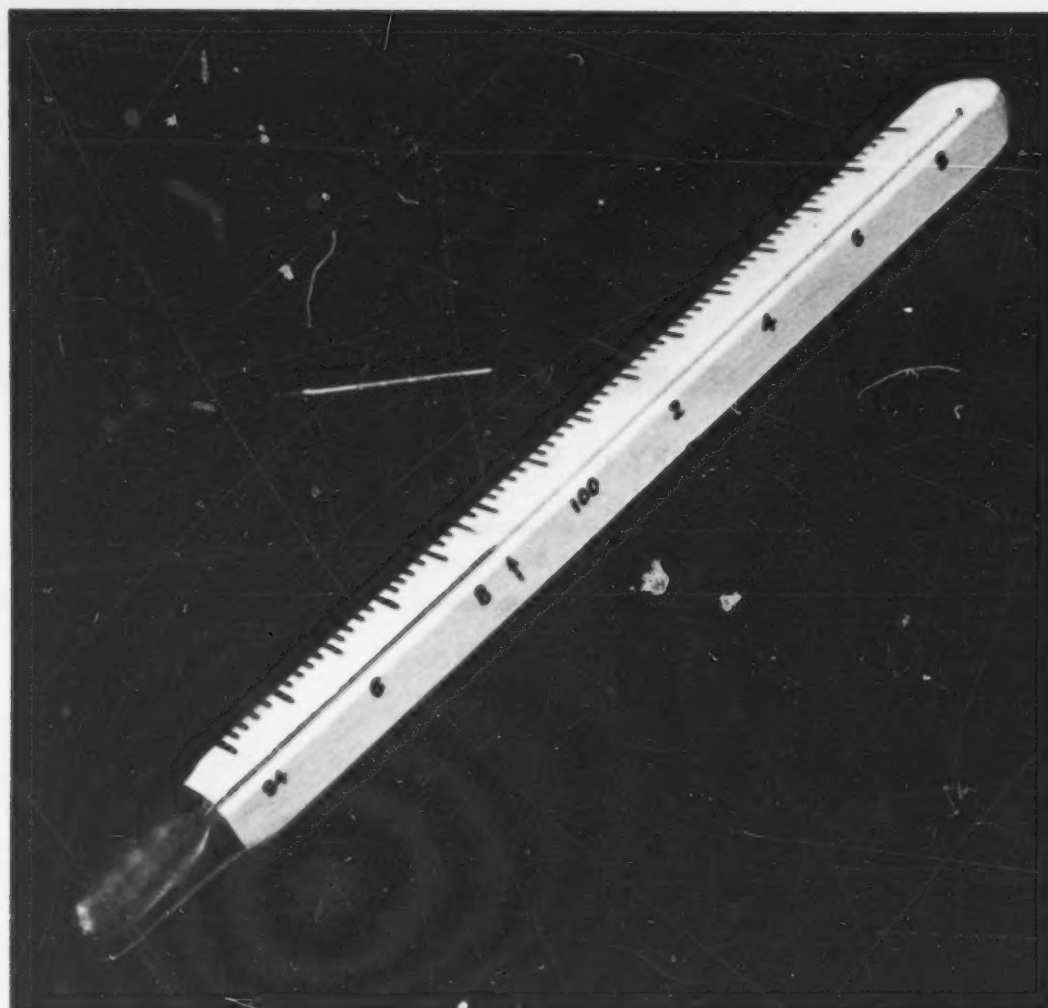
Anderson, Indiana



Helen Steinway

Central High School

Cincinnati, Ohio



CLINICAL THERMOMETERS

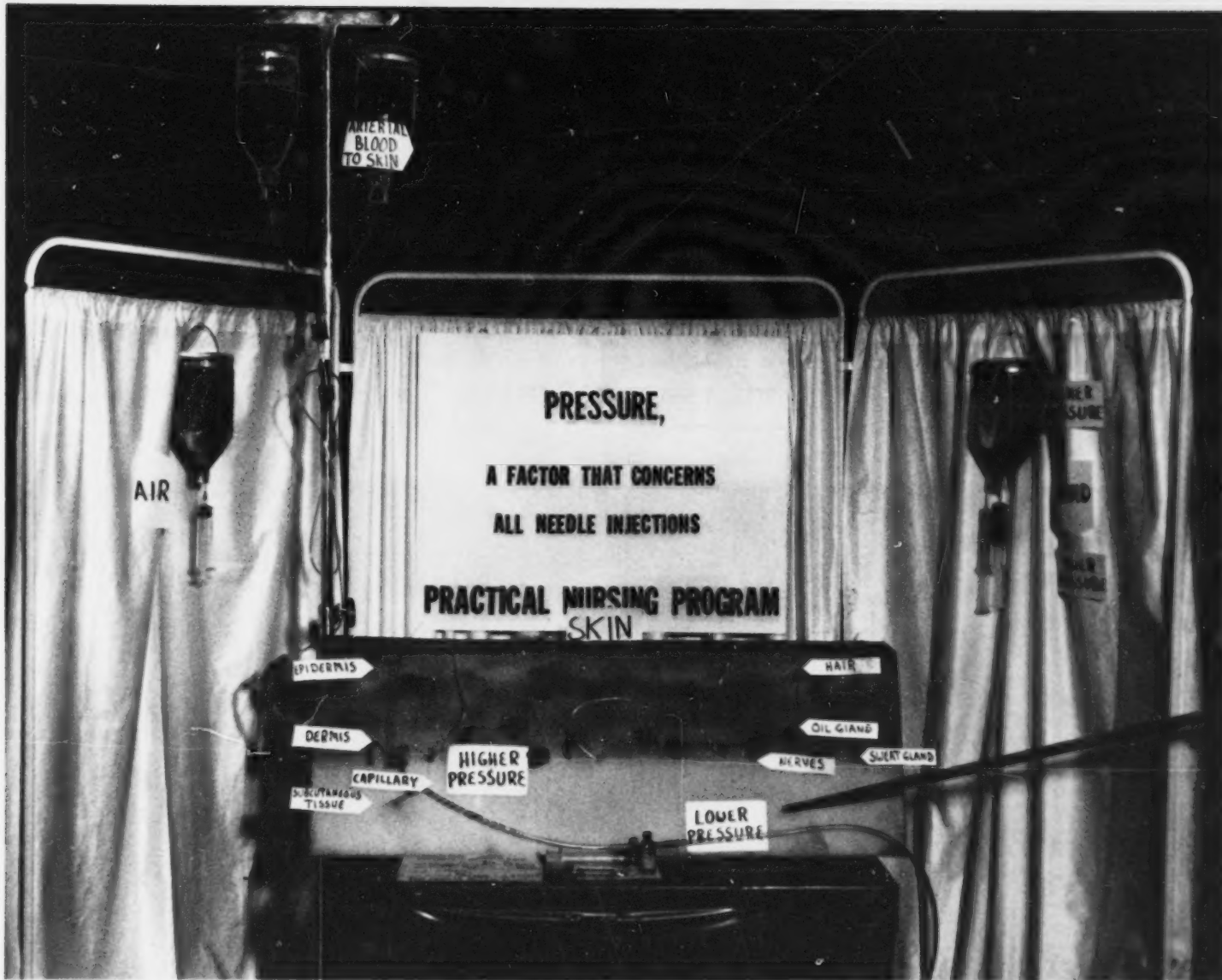
Enlarged clinical thermometers made of wood, with an adjustable mercury column, and with graduations identical to those on clinical thermometers facilitate the teaching of

practical nurses to read accurately the thermometer and differentiate between the two scales.

Practical Nursing Dept.

Jane Addams Vocational High School

Cleveland, Ohio



PRESSURE MOCK-UP

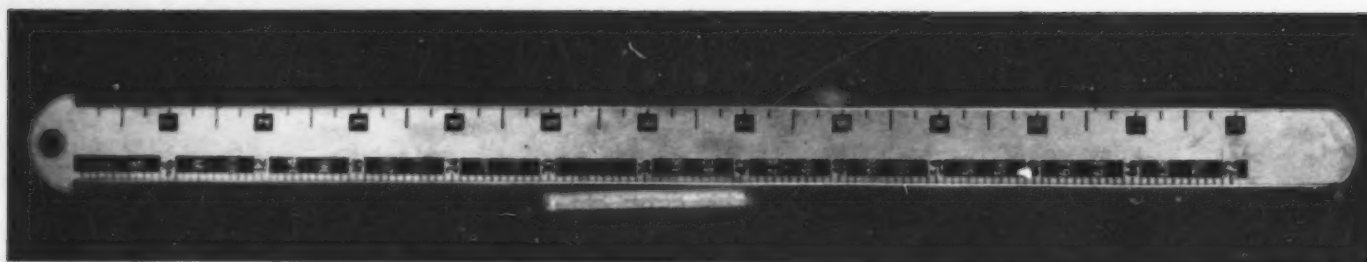
The relationship of gravity and pressure to the absorption of fluids injected into body tissues is shown in this teaching aid. Better understanding of the administration of medica-

tions and fluids into the tissue can be gleaned through the use of a mock-up.

Sandra Rasmussen

Chicago Practical Nursing Center

Chicago, Illinois



PRINTERS LINE GAUGE

This is an enlarged model of a printers line gauge used to illustrate the relation of picas to inches and to avoid the

awkwardness of covering the etchings with fingers while exploring the scale.

Richard I. Jacques

Kansas State College of Pittsburg

Pittsburg, Kansas



PLATEN PRESS LOCKUP

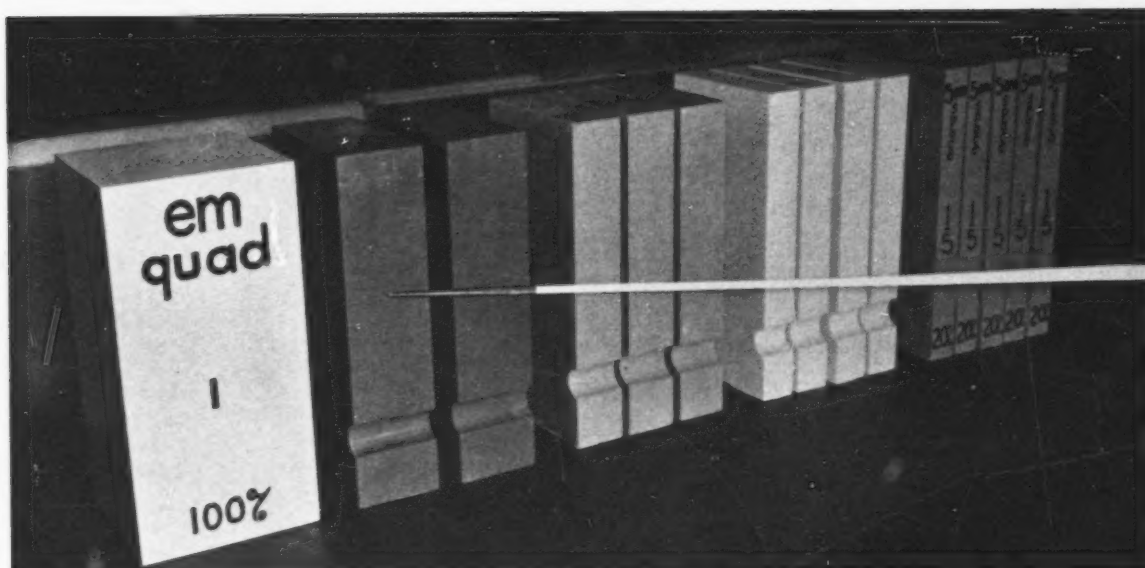
The fundamental principles of platen press lockup, as well as the more advanced phases or steps of lockup, are easily explained with this unique type of demonstration. The chase, painted to look like metal, the reglets, and the furniture, all made of felt-backed balsa wood, are of identi-

cal size and workability as their counterparts in the shop. The form is an authentic rubber plate mounted on felt-backed balsa and painted a metallic color for realism. In demonstration, the felt-board is used as the stone. Metallic painted balsa quoins are used to secure the form and furniture.

G. Richard Lawson

Indiana State Teachers College

Terre Haute, Indiana



ENLARGED MODELS OF SPACES AND QUADS

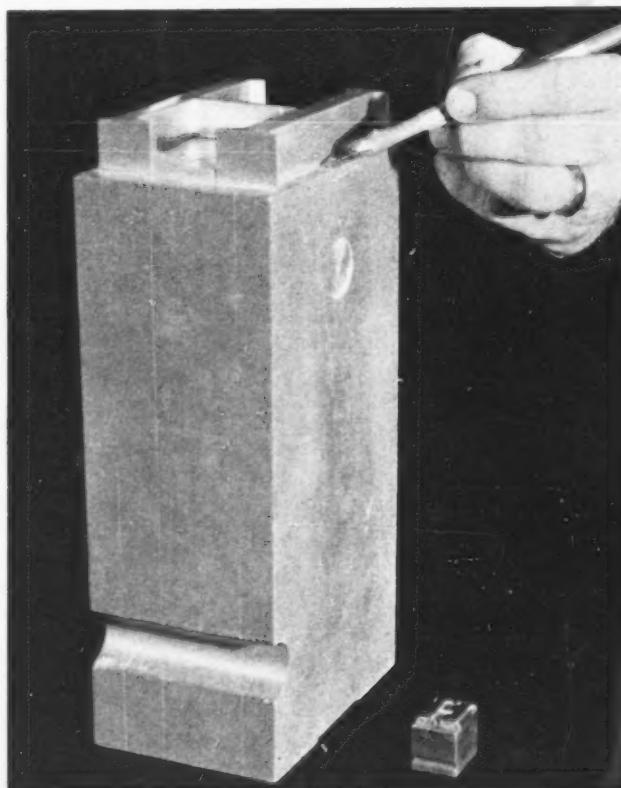
The enlarged replicas of spaces and quads, made of lightweight wood, give the graphic arts student practice in comparing the various sizes of spacing material in relation-

G. Richard Lawson

Indiana State Teachers College

ship to the em quad. This relationship may be made in percentage and/or fractional form. All quads and spaces are marked on the back for easy identification.

Terre Haute, Indiana



TYPE MODEL

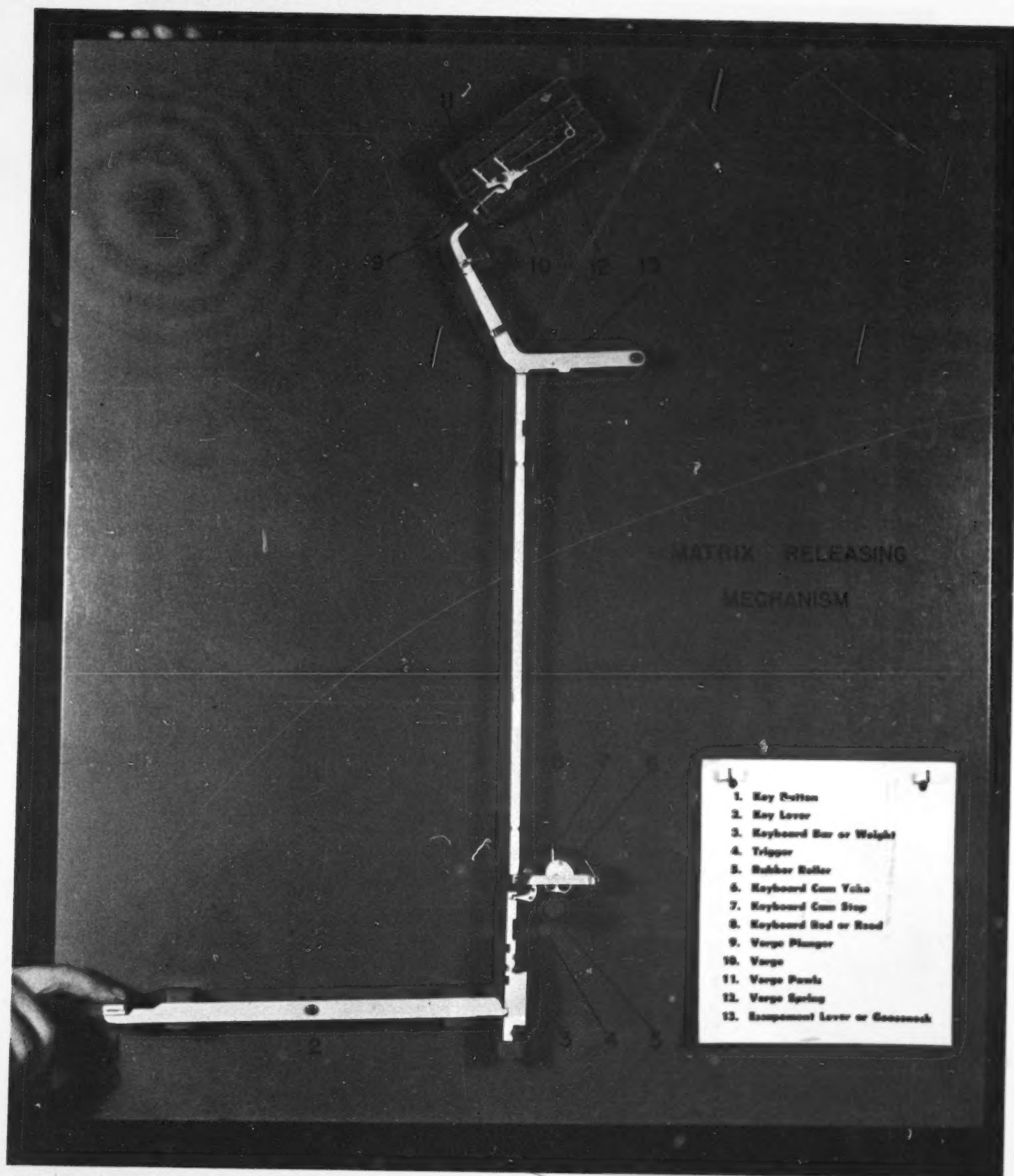
The principal parts of a piece of type, and its construction features, can be readily shown to the class with a large model. The above model is made to scale from an 18 point

G. Richard Lawson

Indiana State Teachers College

type using a 20 to 1 ratio. Similar models are particularly helpful in aiding students to distinguish a "b" from a "p" and the "d" from the "q".

Terre Haute, Indiana



LINOTYPE MATRIX RELEASING MECHANISM

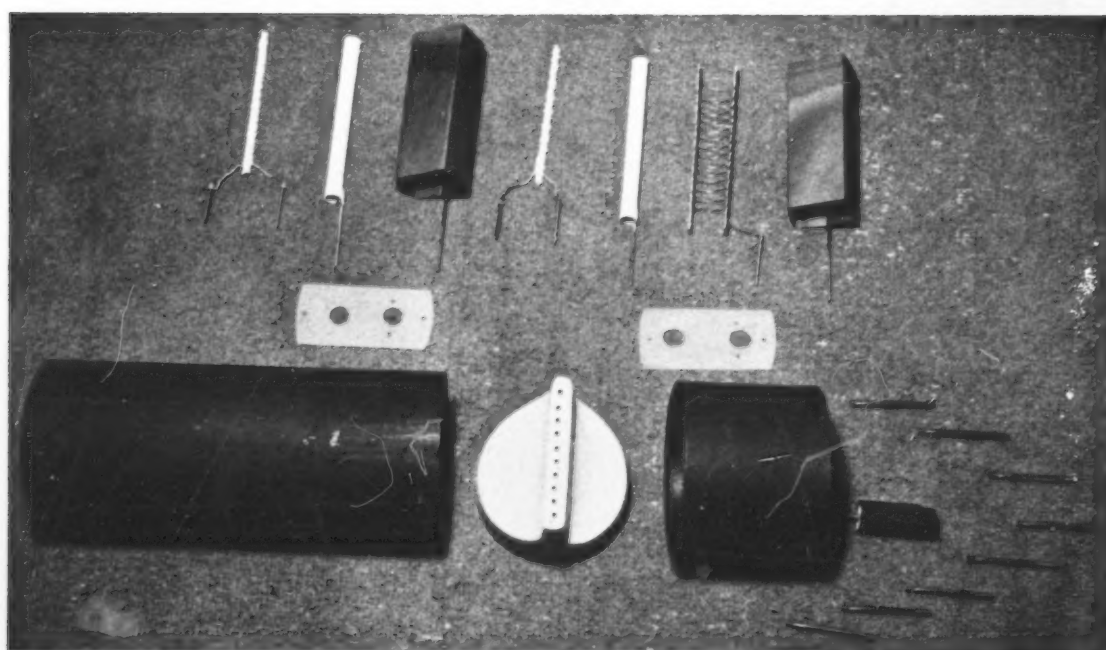
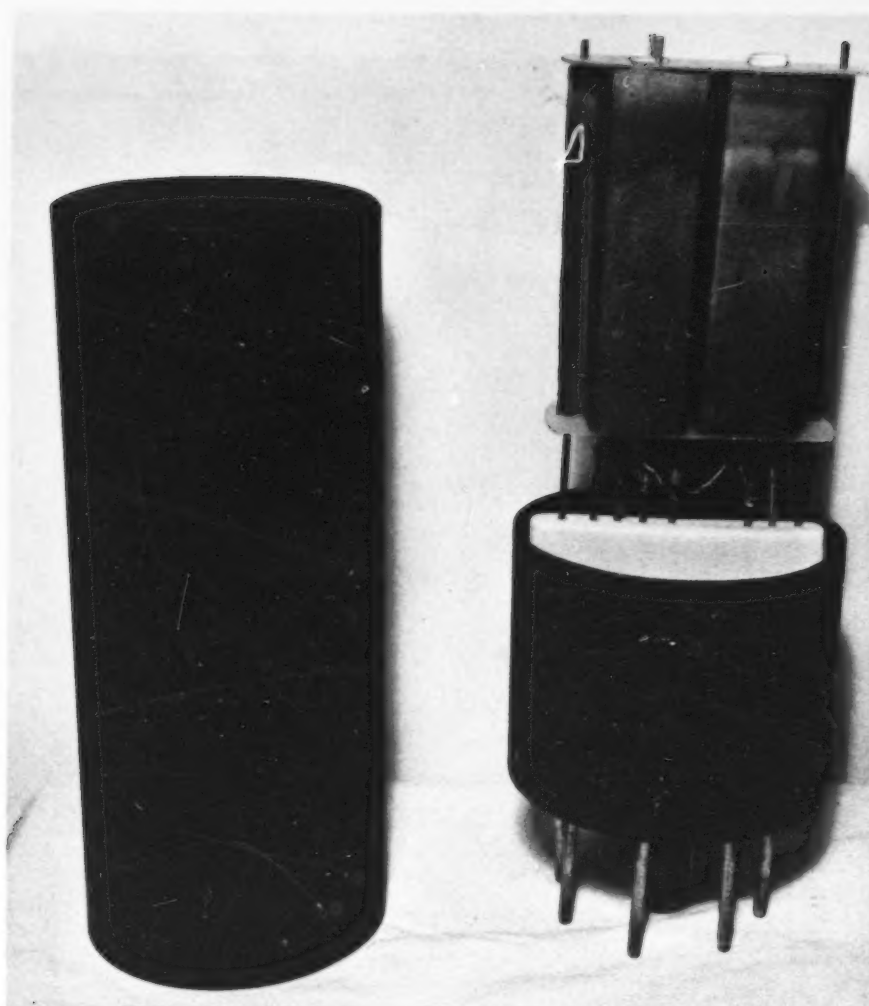
This device is used to show the parts and method in which a matrix is released from a magazine on a Linotype. All pieces are actual parts from a Linotype. The legend is

Richard I. Jacques

removable so that the model can be used for giving a test over the parts.

Kansas State College of Pittsburg

Pittsburg, Kansas



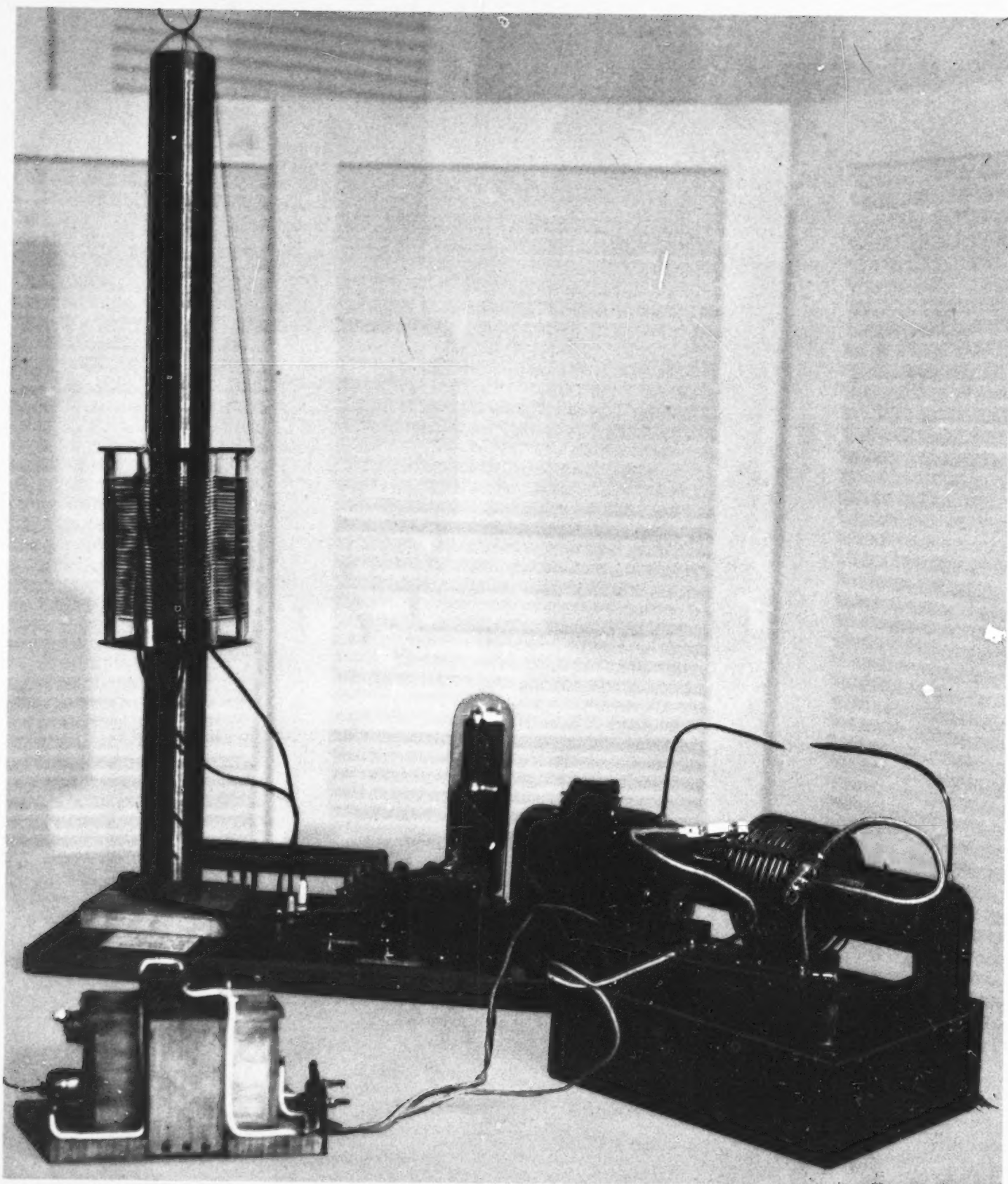
MODEL VACUUM TUBE

This 21'' model permits the students to follow the teacher closely during demonstrations. The elements in the vacuum tube and their relation to each other are understood quickly and clearly.

Gerald R. Quilling

Lincoln Park H. S.

Lincoln Park, Michigan



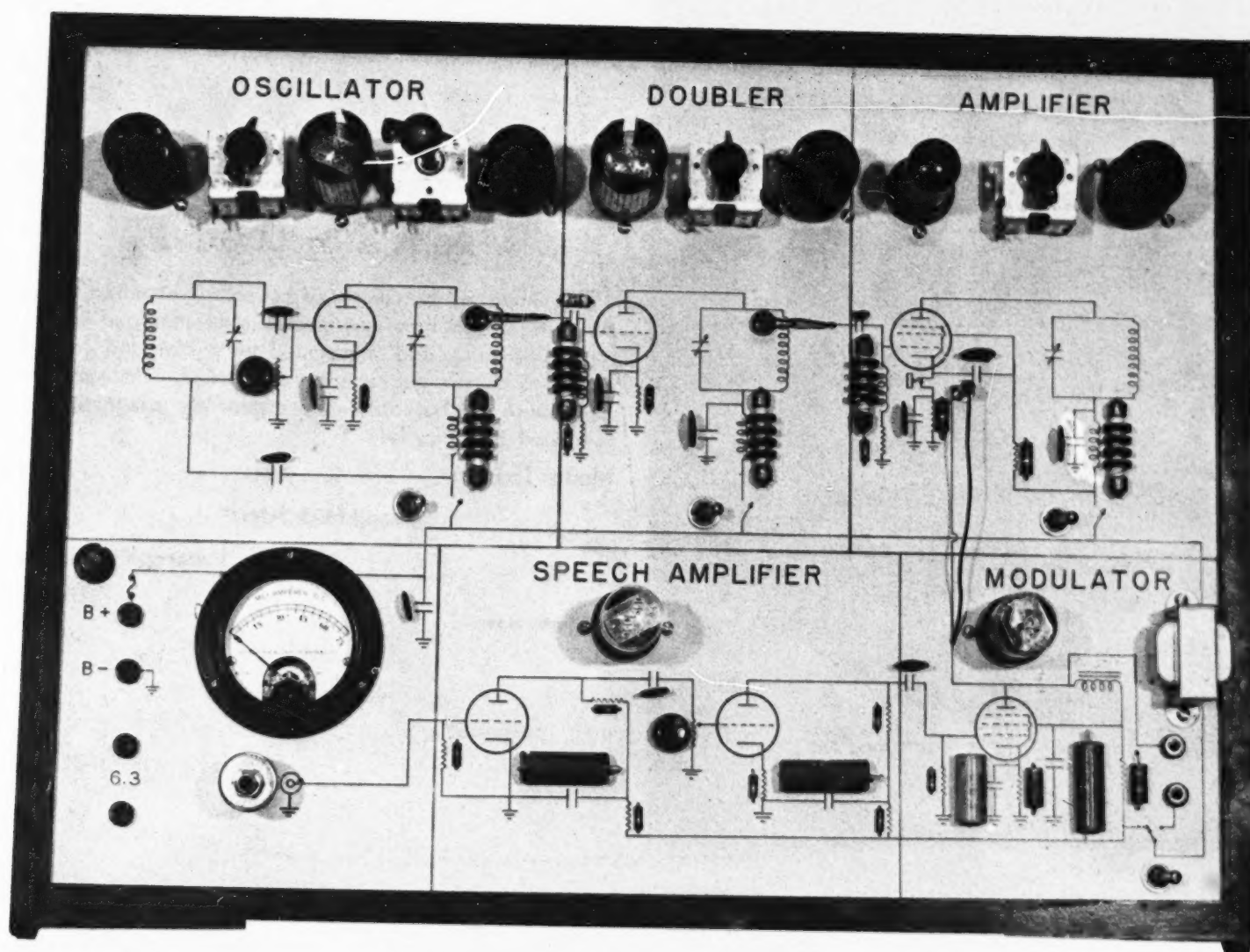
TESLA COILS

These student-made Tesla coils are designed to demonstrate high frequency and radiation patterns.
In addition, this aid is designed to familiarize students with the transmission of radio waves.

Donald Thompson, Michael Durkin, John Henry

Central High School

Cincinnati, Ohio



DEMONSTRATION TRANSMITTER

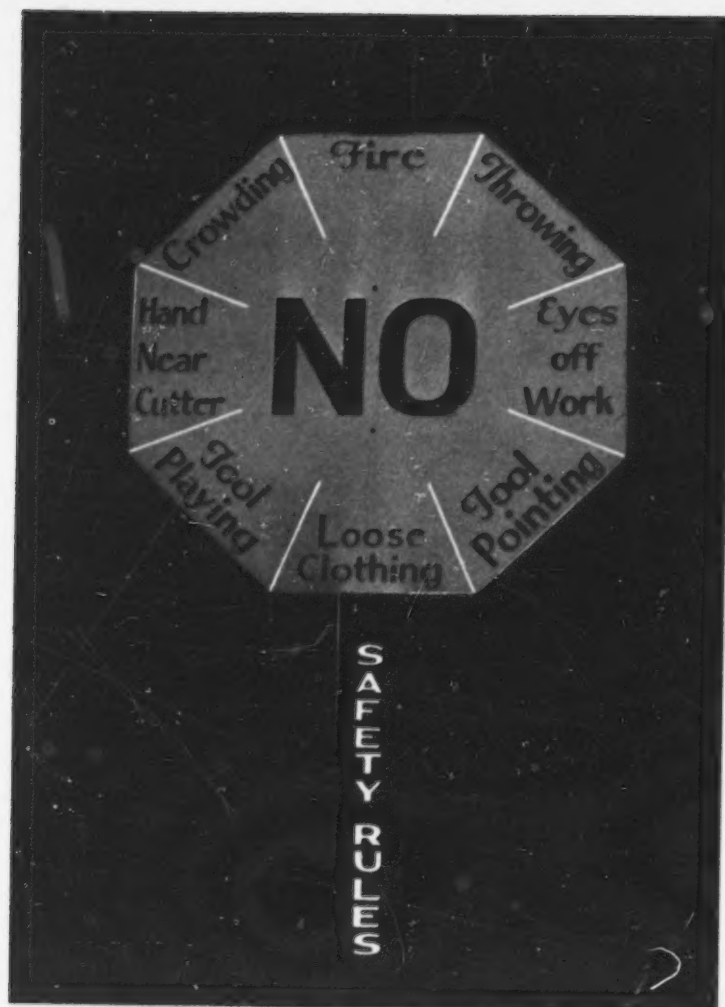
This mock-up aids students in understanding how radio frequencies are generated and transmitted. This includes principles of oscillators, doublers, R.F. power amplifiers, and methods of modulation. Accessories required are: "B"

Robert Tenneson

power supply of 300 VDC at 100 ma., 6.3 volts at 3 amperes, a general purpose oscilloscope, and a broadcast receiver which has provisions for a beat frequency oscillator.

Stout State College

Menomonie, Wisconsin



SIGNS AND SLOGANS

Accidents can be minimized by calling attention to the many hazards that are ever present in the shop and laboratory. The safety aid is mounted on casters and can be moved to chronic danger areas as needed. The masonite sign boards can be easily changed and the safety message is altered periodically.

Marion Lagrotto

Wood High School

Indianapolis, Indiana



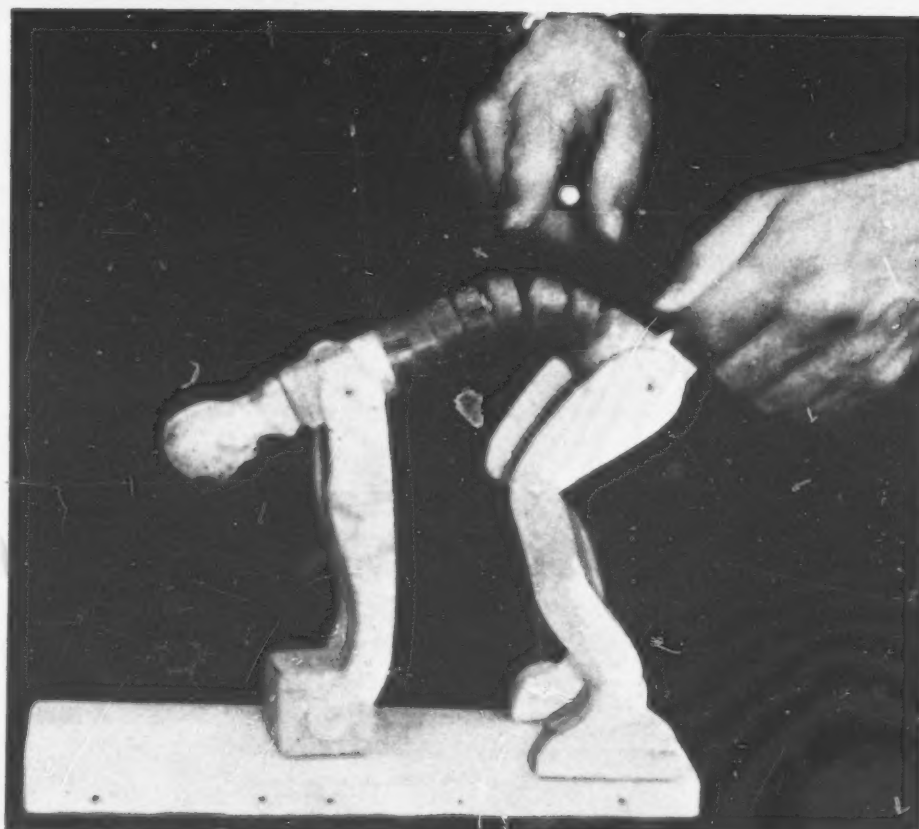
LIFTING

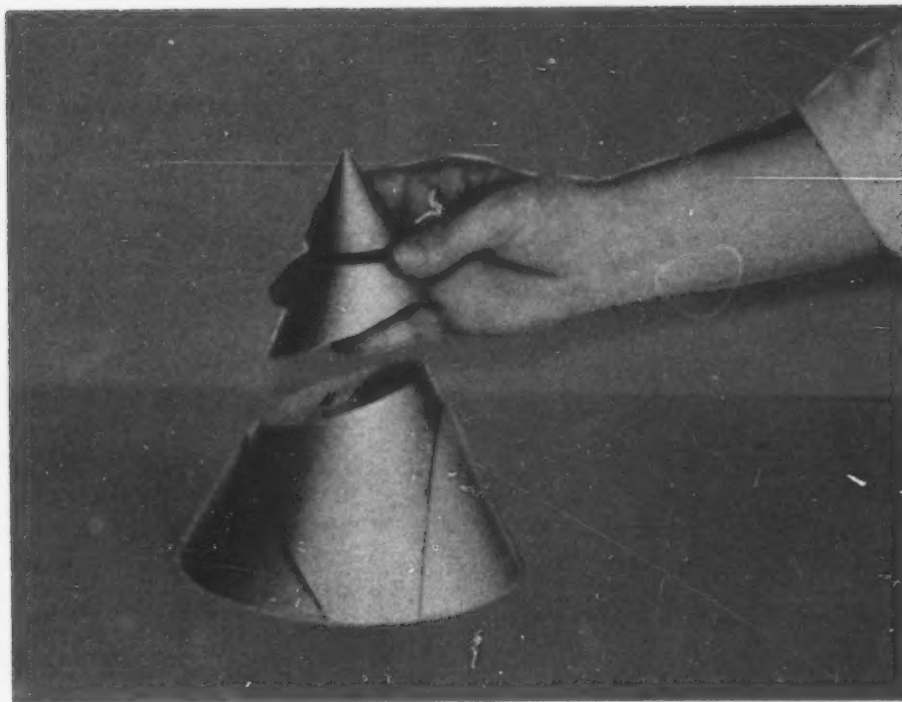
This model is used to illustrate the proper ways of lifting. It is very helpful in showing students the action that takes place in the back when incorrect lifting methods are used. This model is used where lifting of heavy material creates injury problems.

Earl Ehlers

State Itinerant Instructor

Madison, Wisconsin





DISSECTED CONE

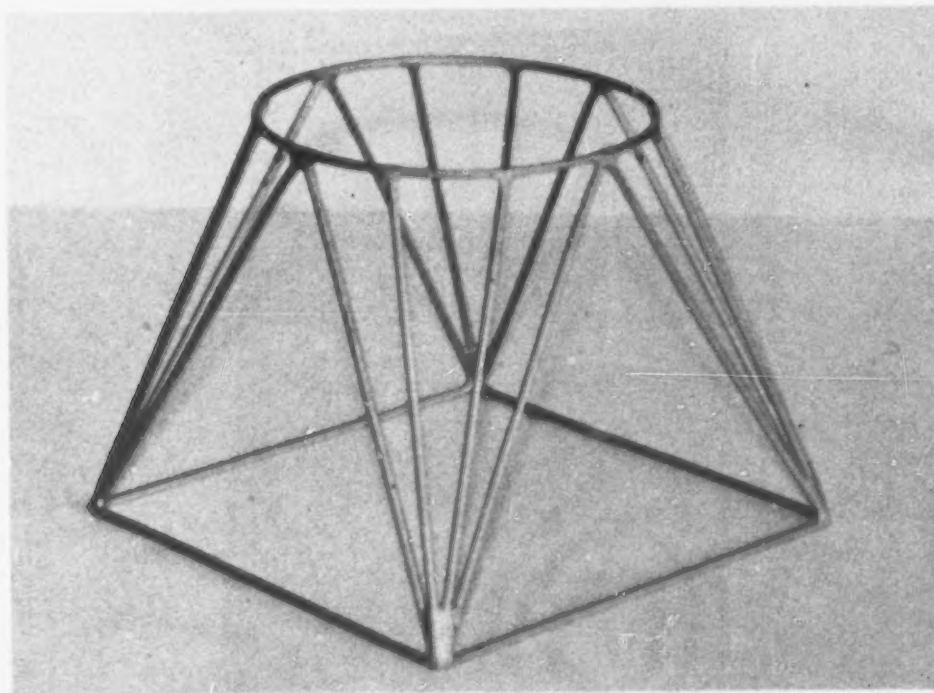
The sheet metal cone, having detachable portions, is used to assist the student in recognizing the various sections. The resulting figure can be traced on a cutting plane, and

the process assists the student to understand intersection and development.

Spencer Hokenson

North Dakota State School of Science

Wahpeton, North Dakota



WIRE MODEL

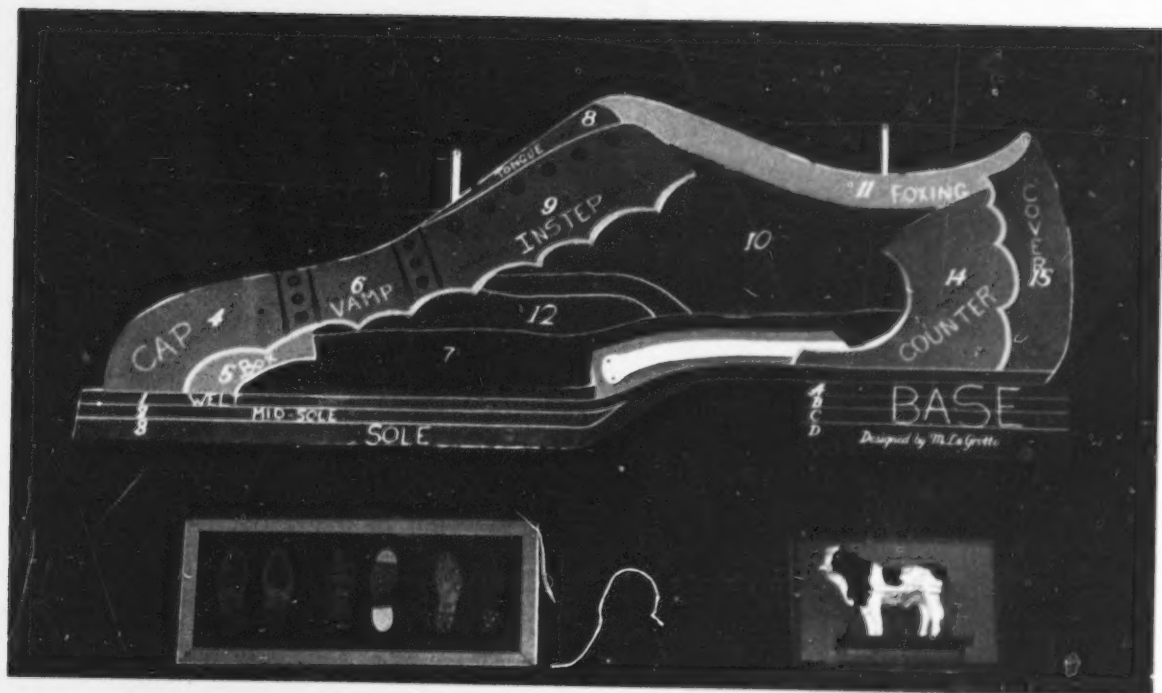
This wire model of a square to round transition is used to demonstrate the position of elements, how they appear in different views, and to assist students in determining true lengths.

Spencer Hokenson

North Dakota State School of Science

Wahpeton, North Dakota

SHOE REPAIR



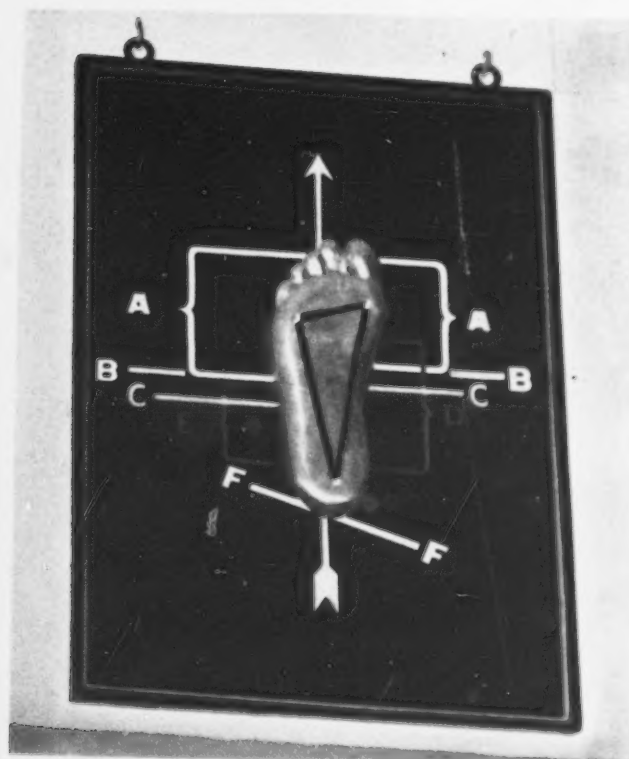
SHOE MODEL

Concealed portions of the shoe are exposed and each component has been assigned a number and identified. The identification can be erased for testing purposes.

Marion LaGrotto

Wood High School

Indianapolis, Indiana



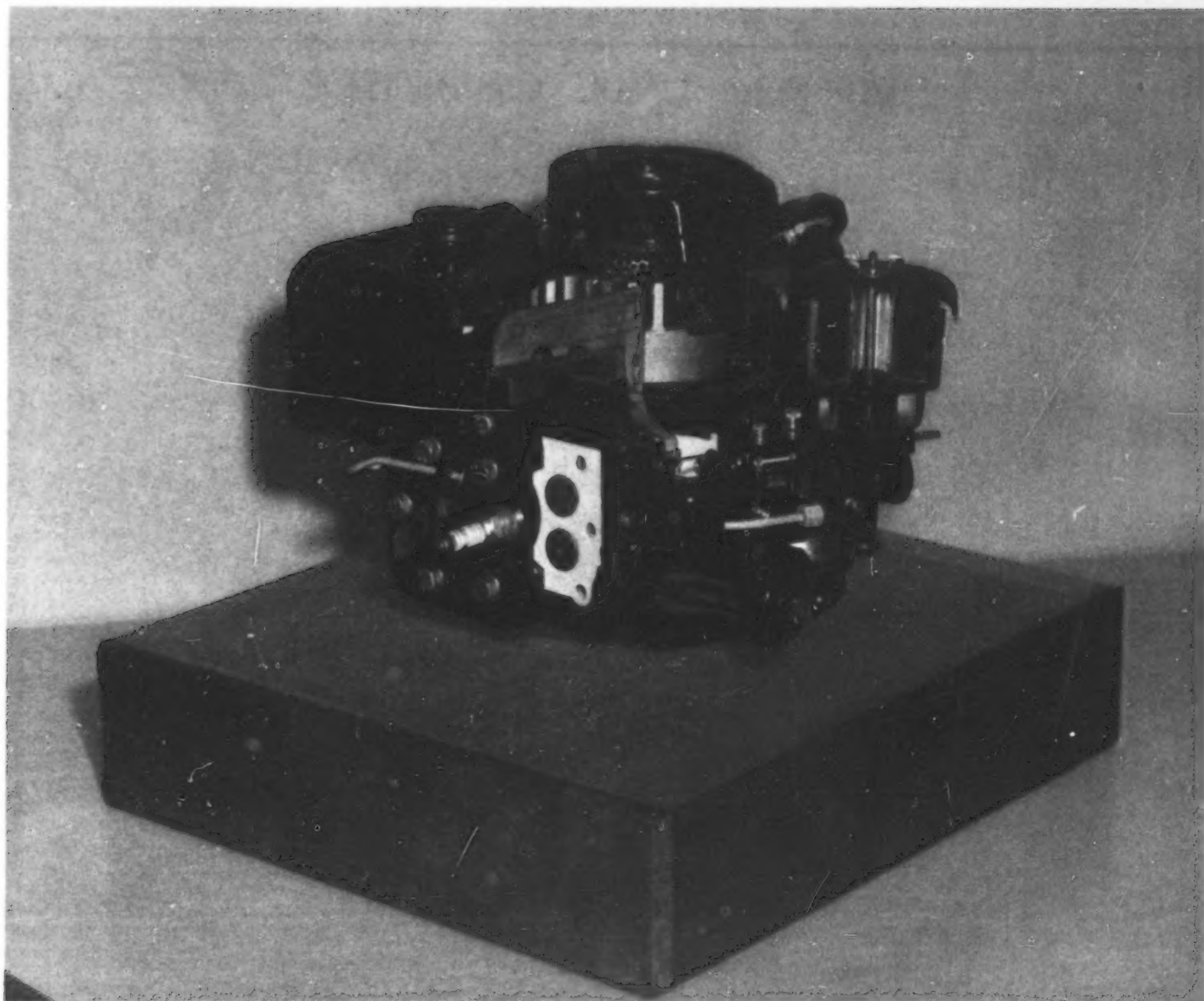
ORTHOPEDIC MODEL AND DIAGRAM

This aid depicts the science of shoe building and rebuilding, such as weight-bearing centers, points of strain, and areas of the foot.

Marion LaGrotto

Wood High School

Indianapolis, Indiana



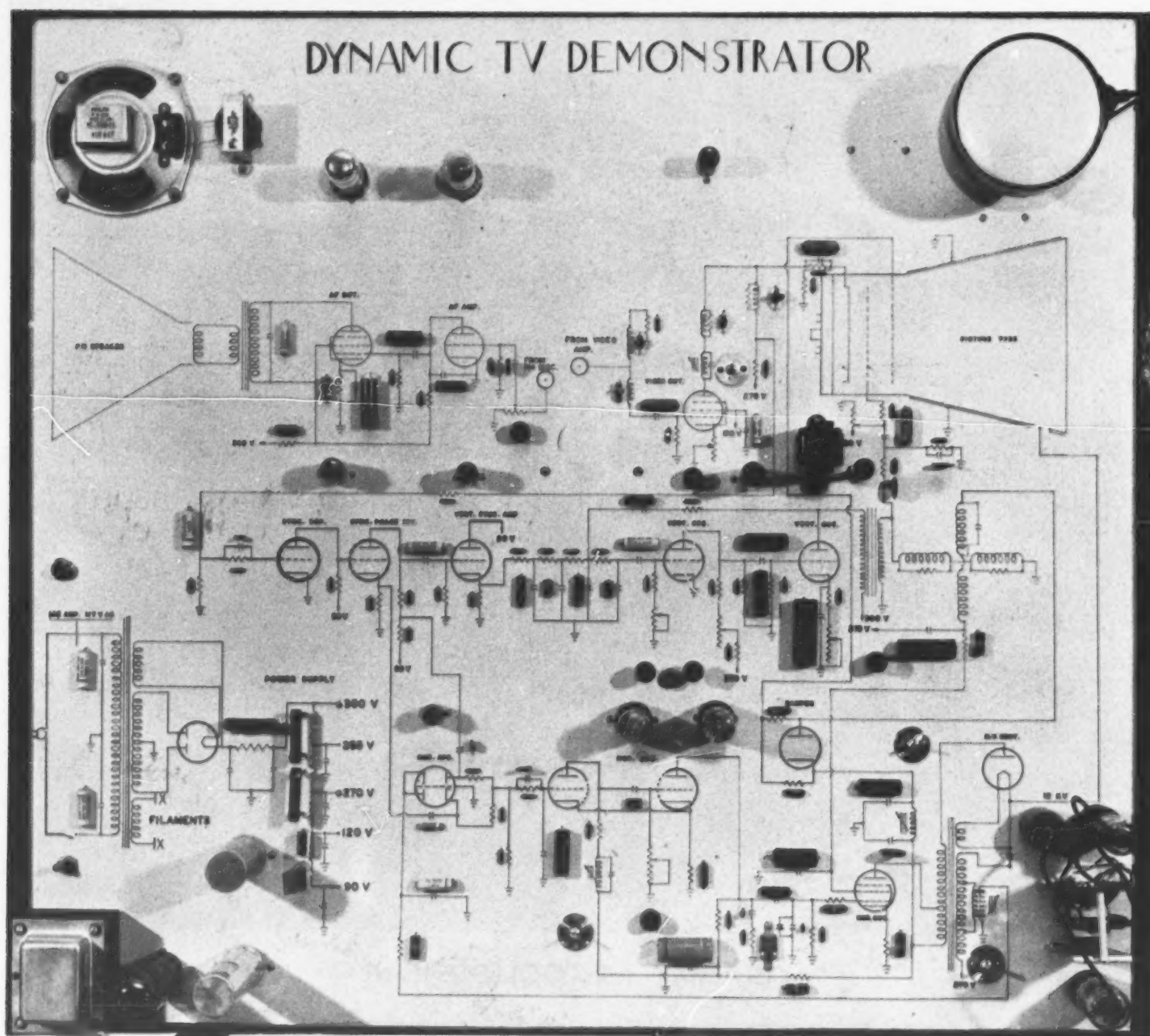
CUTAWAY AIR COOLED ENGINE

This model facilitates instruction on internal construction, adjustment,
and function of small engines and their components.

William G. Turner

Indiana State Teachers College

Terre Haute, Indiana



DYNAMIC T.V. DEMONSTRATOR

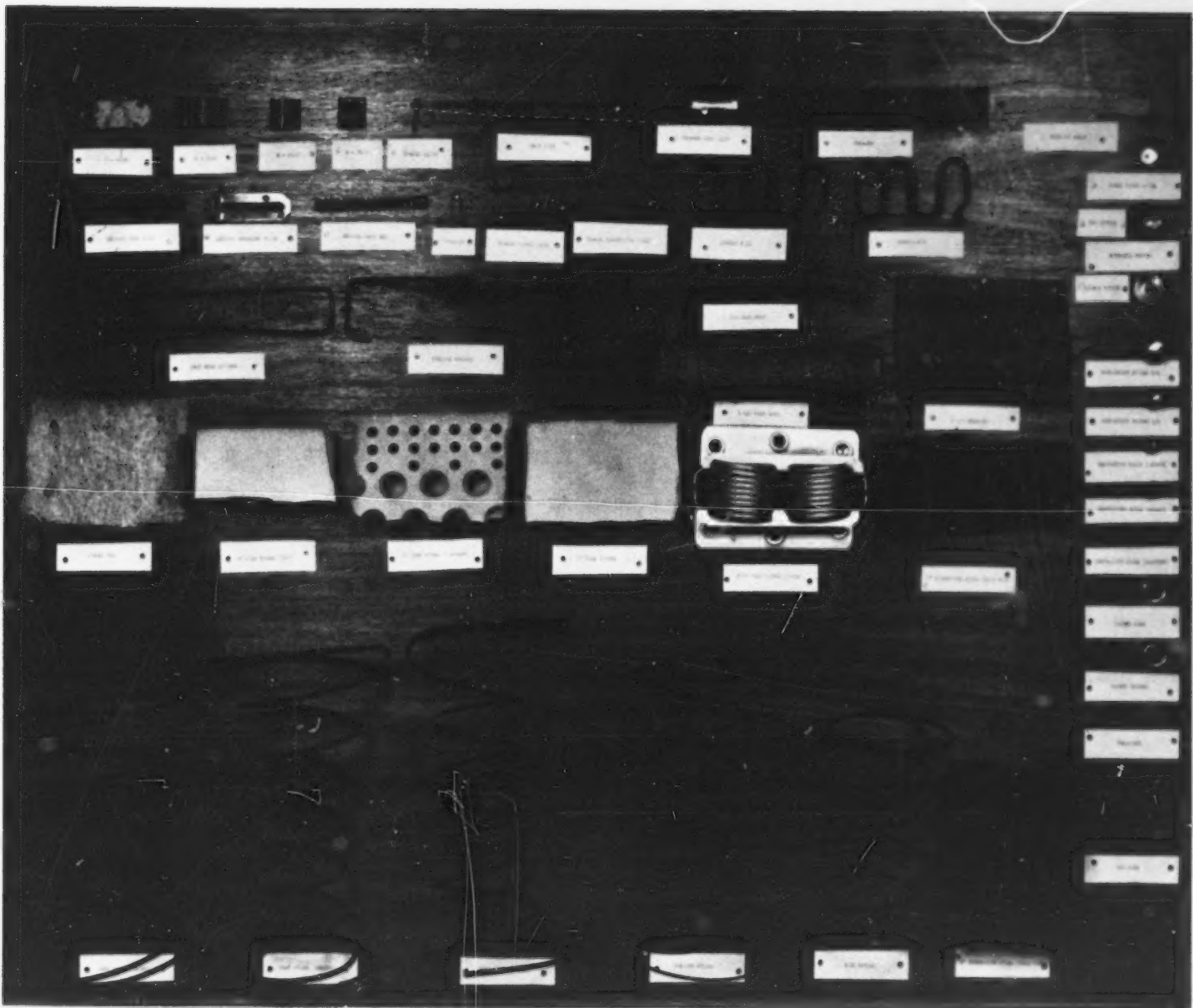
This device aids the students in understanding the principles of the video amplifier, sync separators and amplifiers, sync oscillators, high voltage power supplies, and cathode ray tubes. Accessories needed are a source of video and sound

signal from the front end and I.F. strip of a T.V. set, an oscilloscope, a T.V. signal generator, and a vacuum tube voltmeter.

Thomas Singletary

Stout State College

Menomonie, Wisconsin



UPHOLSTERY DISPLAY BOARD

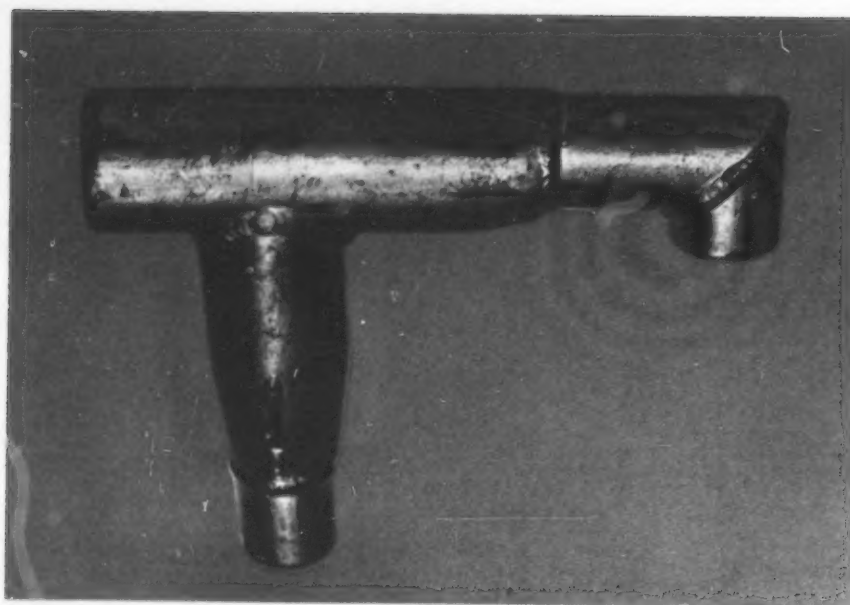
This display board shows many of the materials and supplies that are frequently used. Correct nomenclature is printed on cards adjacent to each article to facilitate learning.

James Farley

Kansas State College of Pittsburg

Pittsburg, Kansas

WELDING



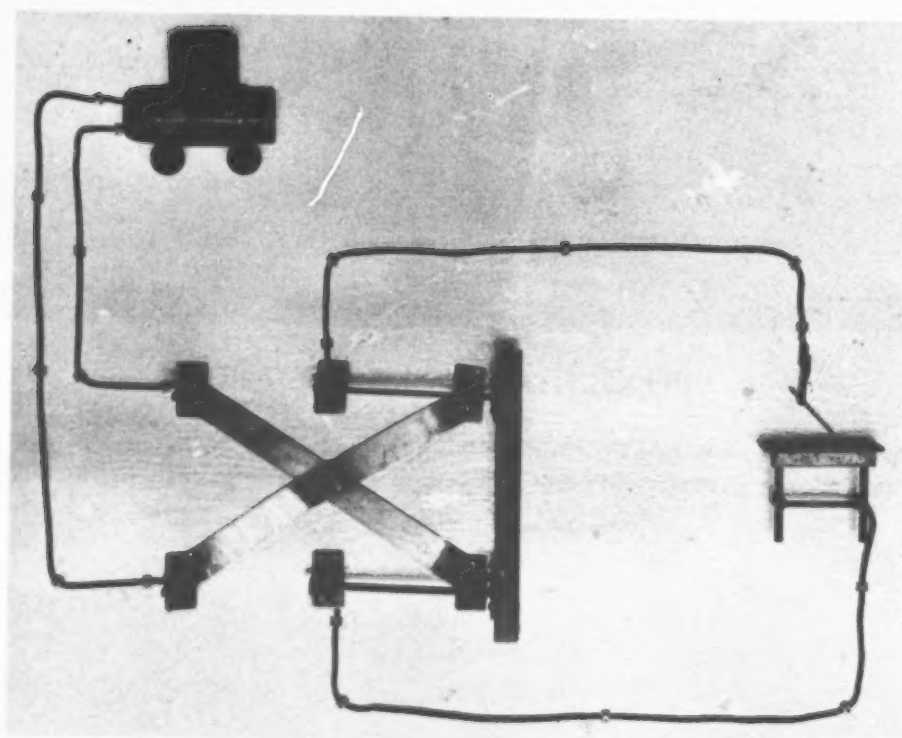
SAMPLE PIPE WELDS

The model shows the standard methods of cutting and fitting iron pipe for assembly using arc and acetylene welding.

John Junkens

Kansas State College of Pittsburg

Pittsburg, Kansas



POLARITY SWITCH

The polarity switch teaching aid is useful when teaching theory and uses of polarity. It aids in giving the student a clear understanding of what actually takes place in the welding generator when the switch is set in straight and reverse polarity. It shows that the positive and negative

charges in the welding circuit are simply re-routed, either to the ground or to the electrode. It also clarifies the action that occurs when the switch is thrown, such as reversing generator rotation, etc.

Raymond C. Richard

Elyria High School

Elyria, Ohio

APPENDIX

Instructor's Check List

Principles and practices that apply to the effective utilization of instructional materials, in general, apply also to the effective use of three-dimensional teaching aids. Check your familiarity with the following list of principles and practices in connection with your next use of these teaching aids.

Planning and Preparing

1. A three-dimensional teaching aid should definitely assist you and your students to attain the objective(s) of the learning session.
2. For improving the learning situation, the teaching aid should be superior to any other teaching technique, aid, or even the real object.
3. The aid should definitely help students to understand what you are attempting to explain.
4. The aid should be used only for the purpose for which it was designed.
5. The aid should be designed so there is no possibility of its conveying the wrong impression.
6. The aid should save time and energy for you and your students during a learning situation.
7. The aid should be up to date.
8. The size of a teaching aid should be determined to some extent by the size of your group of students.
9. The aid should be commensurate with the age level, mental ability, and background of your students.
10. The aid should cause the students to think.
11. The aid should stimulate activity in each student.
12. The aid should teach a principle or help develop a concept.

13. An appropriate introduction should precede the presentation of an aid.
14. A sufficient number of illustrations or applications of the main principle of the aid should be prepared in order to enhance the learning situation.
15. Ample time should be given to a question-and-answer period after the aid has been presented.
16. The aid should be in good condition and working parts should function properly.
17. Make certain you thoroughly understand the aid and are proficient in its use.
18. Presentations should be rehearsed.
19. Make sure that the aid is ready and available when you expect to use it.
20. Supplementary aids should be introduced at an appropriate time.

Making the Presentation

21. Secure the undivided attention of the group before making the presentation.
22. Make certain the students know what the 3-D aid is, why it is being used, what to look for, and what they should understand and be able to do as a result of the presentation.
23. Relate the past and projected experiences of your students to the purpose of this particular teaching aid.
24. The aid should be presented so that each student can see it and can hear you.
25. Use proper terminology; write new terms on the chalkboard and explain them during the presentation.
26. A list of performance steps for the operation should be clearly defined if the aid involves a basic operation or procedure.
27. Correct safety practices should be employed as the aid is demonstrated.

28. Student understandings should be checked as the presentation progresses.
29. Questions from the group should be encouraged if you feel the students are not fully understanding the presentation.
30. The aid should be handled with gentle firmness to assure its future usage.

Student Performance

31. If a student is to assist you with the presentation, thoroughly brief him first.
32. If students are to operate the aid, give them explicit instructions for proper use.
33. Properly supervise students while they are demonstrating the aid.
34. Allow the students ample time to use and discuss the aid.
35. Proper recognition should be given to students who perform well with the aid.

Terminating the Presentation

36. Summarize the key points of the presentation and the purpose for using the aid.
37. A list of references and sources of additional information on the operation or concept

portrayed by the aid should be given to the students.

38. Test your students for the competencies you have attempted to develop.
39. Remove the aid from the classroom after it has served its purpose so that it will not distract attention from the remaining portion of your lesson.

Storing the Aid

40. Adequate storage should be provided for all instructional aids.
41. A plan for the systematic inspection and servicing of teaching aids should be developed.
42. A listing of all three-dimensional and other teaching aids should be maintained and kept current.

It is probably evident to you and any other instructional personnel who may review this check list that a three-dimensional teaching aid is not meant to replace a teacher or to be a substitute for good instruction. Rather, as the term "teaching aid" implies, it is but one tool a teacher may use to enhance the learning situation and to insure attainment of the objectives of the lesson and the course.